SEGMENT DISCLOSURES, INTERNAL CAPITAL MARKETS, AND FIRM VALUE: EVIDENCE FROM SFAS NO. 131

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SEGMENT DISCLOSURES, INTERNAL CAPITAL MARKETS, AND FIRM VALUE: EVIDENCE FROM SFAS NO. 131

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Using the adoption of SFAS 131 as an exogenous change in disclosure quality of segment information, this study examines the impact of SFAS 131 on internal capital market efficiency and firm value. It finds that diversified firms that changed their segment definitions on adopting SFAS 131 (i.e., "change firms") experienced greater improvement in capital allocation efficiency in internal capital markets in the post-SFAS 131 period relative to the pre-SFAS 131 period than did a control sample of diversified firms that did not change their segment definitions (i.e., "no-change firms"). This result holds in a battery of tests designed to correct for the endogeneity in firms' reporting choices following SFAS 131, suggesting that disclosure quality improves external monitoring and therefore investment efficiency. This study further shows that the improvement in capital allocation efficiency was achieved primarily by firms whose boards of directors were relatively less independent in the pre-SFAS 131 period, suggesting that the strength of internal monitoring moderates the effect of disclosure quality (as a mechanism of external monitoring) on investment efficiency. In addition, it finds that proprietary costs moderate the impact of SFAS 131 on firm value. Specifically, change firms experienced a greater increase in firm value in the post-SFAS 131 period relative to the pre-SFAS 131 period than did no-change firms except for a subsample of firms with high proprietary costs, suggesting that SFAS 131 reduced agency costs but also eroded competitive advantages.

BIOGRAPHICAL SKETCH

Young Jun Cho is an Assistant Professor of Accounting at the Singapore Management University. He received his Ph.D. and M.S. in Management from Cornell University, M.S. in Accountancy from the University of Illinois at Urbana-Champaign, and Master of Business Administration, B.A. in English Language and Literature, and B.A. in Sociology from Yonsei University.

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1. Introduction

This study provides evidence that SFAS 131 (Statement of Financial Accounting Standards No. 131 "Disclosures about Segments of an Enterprise and Related Information") improved the efficiency with which firms allocate internal capital from low-opportunity segments to high-opportunity segments but had offsetting effects on firm value.[1] SFAS 131 increased firm value by improving the monitoring of managers but, on the other hand, decreased firm value by revealing proprietary segment information. The net effect of SFAS 131 was to increase value for firms whose segments operate in more competitive industries but reduce value for firms whose segments operate in less competitive industries.

Like Botosan et al. (2009), my results indicate that SFAS 131 accomplished its stated goal of providing investors with better information on how diversified firms operate their segments and how each segment performs (FASB 1997, Para. 3-8).[2] Moreover, my study shows that the improved disclosure has a direct impact on how the firm allocates capital across segments. The study therefore extends the literature that investigates the relation between financial reporting quality and corporate investments.[3] Existing studies generally suggest that accounting quality alleviates underinvestment because it decreases information asymmetry and thus adverse selection problems in *external* capital markets. My study is among the first to establish

[1] Adopted for firms with fiscal years beginning after December 15, 1997, SFAS 131 supersedes SFAS 14 (Statement of Financial Accounting Standards No. 14 "Financial Reporting for Segments of a Business Enterprise") and requires firms to define their segments for financial reporting purposes to be consistent with those for internal decision-making. Relative to SFAS 14 that defines a segment based on its industry (as identified by managers), SFAS 131 reduces managerial discretion in segment disclosures because it demands that reported segments be aligned with internal organizational structures.

[2] I use the terms "diversified firm" and "multiple-segment firm" interchangeably throughout the paper to refer to a firm that reports multiple operating segments in its 10-K. In addition, I use the terms "stand-alone firm" and "single-segment firm" interchangeably to refer to a firm that does not report multiple operating segments.

[3] See, for example, Bushman and Smith (2001), Healy and Palepu (2001), Bens and Monahan (2004), Bushman et al. (2006), Biddle and Hilary (2006), Lambert et al. (2007), Hope and Thomas (2008), McNichols and Stubben (2008), Biddle et al. (2009), Beatty et al. (2009), Beatty et al. (2010), Francis and Martin (2010), and Garcia Lara et al. (2010).

a link between disclosure quality and *internal* capital markets.[4]

Berger and Hann (2003) suggest that SFAS 131 improved the monitoring environment. My study is motivated by the observation that improved monitoring should not only reveal agency problems (as argued by Berger and Hann (2003)), but should also reduce them. To test for such effects, I conduct a difference in differences analysis by focusing on a sample of firms that existed as diversified firms in both pre- and post-SFAS 131 periods (henceforth known as "multiple-to-multiple firms). The use of multiple-to-multiple firms allows me to compare the effect of SFAS 131 on a group of diversified firms that changed their segment definitions (henceforth known as "change firms") to the effect of the same standard on a control group of diversified firms that did not change their segment definitions (henceforth known as "no-change firms"). While SFAS 131 is mandatory, if a firm already reported its segments as aligned with internal organizational structures (as demanded by SFAS 131), it did not need to change its segment definitions on adopting SFAS 131. The difference in differences analysis enables me to parse out the effect of reporting changes following SFAS 131 from other economic changes during the sample period.

To measure cross-segment transfers before and after SFAS 131, I hand-collected segment information restated in compliance with SFAS 131 (disclosed in the first year's 10-Ks after SFAS 131) for change firms' pre-SFAS 131 segment data. By using segment information prepared by the same standard for both pre- and post-SFAS 131 periods, this study eliminates the possibility that any observed improvement in capital allocation efficiency may be a mere artifact of more disaggregated segment data. Using Rajan et al.'s (2000) measure of cross-segment transfers, I find that change firms allocated more (less) capital to segments with better (poorer) investment

[4] Diversified firms are reported to rely less on *external* financing because they can use *internal* capital markets to fund their projects (Ettredge et al. 2006). Without the evidence reported in this study, therefore, one could argue that disclosure quality may not be important for diversified firms. However, this study suggests that disclosure quality does matter in *internal* capital markets.

opportunities in the post-SFAS 131 period relative to the pre-SFAS 131 period to a greater extent than did no-change firms. This result holds with an alternative measure of capital allocation efficiency based on Billett and Mauer's (2003) proxy for subsidy. In addition, I find that more efficient capital allocation results in enhanced firm value. Taken together, these results are consistent with the claim that high-quality disclosures improve external monitoring and, therefore, investment efficiency (e.g., Biddle and Hilary 2006; Biddle et al. 2009, etc).

Given that SFAS 131-type segment information was already available to managers and boards of directors before the adoption of SFAS 131, however, these results would be surprising if firms have strong internal monitoring. To better understand the role of internal monitoring, I conduct additional analyses after dividing the sample firms into subsamples of high vs. low board independence. These analyses demonstrate that the improvement in capital allocation efficiency after the adoption of SFAS 131 was achieved primarily by firms whose boards of directors were relatively less independent in the pre-SFAS 131 period, suggesting that the strength of internal monitoring moderates the effect of disclosure quality (as a mechanism of external monitoring) on investment efficiency.

My results also clarify existing evidence on how SFAS 131 affected firm value. Berger and Hann (2003) find that single-to-multiple firms (i.e., those reported as single-segment firms under SFAS 14 but as multiple-segment firms under SFAS 131) suffered a value decrease when they began disclosing segment information. Berger and Hann (2003) interpret this as evidence that SFAS 131 revealed agency problems associated with internal capital markets. However, an alternative explanation is that improved disclosures imposed proprietary costs on multiple-segment firms. Preparers expressed concerns about such costs during FASB deliberations over SFAS 131 (FASB 1997, Para. 62), and empirical evidence confirms that proprietary costs drive segment aggregation (Harris 1998; Botosan and Stanford 2005; Bens et al. 2009).

To test for the impact of proprietary costs on firm value, following Harris (1998) and Botosan and Stanford (2005), I measure the persistence of abnormal profits of industries in which each segment operates. I find that change firms experienced a greater increase in firm value in the post-SFAS 131 period relative to the pre-SFAS 131 period than did no-change firms in a subsample of firms with low proprietary costs (i.e., those whose segments operate in industries with relatively low persistence of abnormal profits). However, when the sample is limited to a subsample of firms with high proprietary costs (i.e., those whose segments operate in industries with relatively high persistence of abnormal profits), this value enhancement disappears, suggesting that high-quality disclosures may increase firm value by reducing agency costs, but the effect is conditional on proprietary costs. This result is consistent with the findings of Harris (1998) and Botosan and Stanford (2005), which suggest that firms tend to aggregate their segments to hide abnormal profits of their segments operating in less competitive industries.

To the extent that segment aggregation is driven by agency and proprietary costs, my change vs. no-change classification could occur at least partially due to strategic considerations by managers. This could bias my analysis in favor of the documented results if no-change firms have a greater tendency than change firms to aggregate segments in a way that masks real capital allocation efficiency. However, the data suggest the contrary. I also find that my results are robust to a battery of tests designed to correct for self-selection biases.

My findings as a whole deliver the following messages. First, SFAS 131 improved the monitoring of managers, resulting in more efficient capital allocation in internal capital markets. Second, greater reporting transparency and improved capital allocation had a positive impact on firm value. However, more transparent segment disclosures not only reduce agency costs but also increase competitive harm, offsetting the effect of SFAS 131 on value for firms with high proprietary costs.

The remainder of this paper proceeds as follows. Section 2 discusses related literature and develops hypotheses. Section 3 describes data and sample selection. Section 4 introduces a measure of capital allocation efficiency. Section 5 provides empirical evidence. Section 6 discusses robustness analyses. Finally, section 7 concludes.

2. Related Literature and Hypothesis Development

2.1. SFAS 131 and Segment Disclosures

Prior studies have examined the impact of SFAS 131 on the information environment. Herrmann and Thomas (2000) and Street et al. (2000) find that SFAS 131 induced firms to increase the number of reported segments and to provide more disaggregated information. Berger and Hann (2003) find a significant reduction in analysts' forecast errors, providing evidence that after SFAS 131 analysts were able to access new information previously hidden under SFAS 14. In addition, Ettredge et al. (2005) find that SFAS 131 increased the stock market's ability to predict a firm's future earnings.

Prior studies also exploit the adoption of SFAS 131 as an experimental setting to examine the motives behind segment aggregation. Using a sample of single-to-multiple firms (i.e., those reported as single-segment firms under SFAS 14 but as multiple-segment firms under SFAS 131), Botosan and Stanford (2005) find that firms took advantage of the latitude in SFAS 14 to obscure the abnormal profitability of their segments operating in less competitive industries. Consistent with the proprietary cost hypothesis (Verrecchia 1983; Wagenhofer 1990; Hayes and Lundholm 1996, Harris 1998, etc), their results suggest that firms tend to mask themselves to appear as if they underperform when they actually outperform their competitors.

Another motive to preclude disclosure is agency costs (Shleifer and Vishny 1989; Nagar 1999; Nagar et al. 2003). Berger and Hann (2007) find that managers tend to withhold information about segments with relatively low abnormal profits when they focus on a sample of firms where agency cost motives dominate (i.e., those identified as having inefficient capital transfers to segments that perform relatively poorly). A related paper by Berger and Hann (2003) finds that single-to-multiple firms suffered a value decrease when they initiated disclosing segment information. The authors interpret this as evidence that SFAS 131 revealed agency problems associated with internal capital markets. They find that the greater the amount of previously hidden cross-segment capital transfers, the greater the reduction in such transfers during the first year after SFAS 131.

In contrast, Hope and Thomas (2008) provide evidence that SFAS 131 has weakened monitoring for multinational firms. This is because SFAS 131 no longer requires a disclosure of segment earnings by geographic areas if operating segments are defined on any basis other than geographic areas. Hope and Thomas (2008) find a greater tendency of "empire building" in foreign operations of multinational firms under SFAS 131.

2.2. Hypothesis Development

A segment of a diversified firm can be funded from the cash flows generated by other segments of the firm.[5] Diversified firms, therefore, can use internal capital markets as an alternative financing mechanism. Internal capital markets can create value because they enable a segment to fund a project that external capital markets

[5] Lamont (1997) finds that oil companies significantly reduced their non-oil investment in 1986 when oil prices fell by 50 percent (the 1986 oil shock), suggesting that diversified firms tend to subsidize their poorly-performing segments. Shin and Stulz (1998) find that a segment's investment is associated not only with its own cash flows but also with the cash flows of other segments.

would not be able to finance. In particular, given that CEOs have superior information about project quality, internal capital markets can achieve more efficient capital allocation than external capital markets as long as CEOs have right incentives to work in shareholders' interest (Weston 1970; Williamson 1975; Gertner et al. 1994; Stein 1997).

However, if right incentives are not provided (through monitoring or contracts), internal capital markets can be inefficient and thus can destroy value because CEOs are often tempted to misallocate internal capital in their own self-interest. The inefficiency is related to agency costs such as CEOs' desires for "empire building" or the rent-seeking behavior of divisional managers, which causes them to finance pet projects with negative net present value or subsidize poorly performing divisions that, if they were stand-alone firms, would not be able to survive (Jensen 1986; Stulz 1990; Scharfstein and Stein 2000; Rajan et al. 2000. etc). However, if improved monitoring after SFAS 131 made it more costly for diversified firms to acquire, keep, or subsidize divisions with poor investment opportunities, managers' self-serving, inefficient cross-segment capital transfers are likely to be mitigated in internal capital markets after SFAS 131.

While the adoption of SFAS 131 is mandatory, if a firm already reported its segments to be aligned with internal organizational structures (as demanded by SFAS 131), it did not need to change its segment definitions on adopting SFAS 131 (firms that did not change their segment definitions are hereafter called "no-change firms"). By contrast, if a firm's reported segments were not consistent with internal organizational structures, the firm was required to make changes in its segment definitions (firms that changed their segment definition to comply with SFAS 131 are hereafter called "change firms"). Given that SFAS 131 has improved the monitoring environment (as suggested by Berger and Hann (2003)), this study hypothesizes that change firms experienced greater improvement in capital allocation efficiency in the post-SFAS 131 period relative to the pre-SFAS 131 period than did no-change firms.

In addition, if SFAS 131 improved monitoring and thus induced more efficient investments, we should observe a greater increase in firm value for change firms than for no-change firms after SFAS 131. However, SFAS 131 could negatively influence firm value if more disaggregated segment disclosures cause competitive harm by releasing proprietary information to competitors. Therefore, this study further hypothesizes that the beneficial effect of SFAS 131 on firm value for change firms is conditional on the relative magnitude of their proprietary costs.

3. Data and Sample Selection

3.1. Data

I obtained segment- and firm-level accounting data from Compustat and firm-level market data from CRSP, both provided by Wharton Research Data Services (WRDS). In addition, for change firms, I hand-collected segment information restated by SFAS 131 for the pre-SFAS 131 period by reading their 10-Ks filed with the SEC in the year the firms first applied SFAS 131.[6] For change firms, I use the restated data hand-collected from 10-Ks as segment data during the pre-SFAS 131 period and use the reported data machine-read from Compustat as segment data during the post-SFAS 131 period. However, for no-change firms, I simply use the reported data from Compustat as segment data during both pre- and post-SFAS 131 periods.

My sample is restricted to the four-year period centered around the adoption of SFAS 131 because most change firms provide restated segment data for just one or two years preceding the adoption of the new standard. Since SFAS 131 is effective for

[6] The use of the restated data allows me to eliminate an alternative explanation that SFAS 131 may not have caused a real change in managerial behavior but only disaggregated the segments of change firms in a way that make capital allocation appear more efficient in the post-SFAS 131 period. Berger and Hann (2003, 2007) also use hand-collected segment data restated following SFAS 131.

fiscal years beginning after December 15, 1997, December year-end firms adopted SFAS 131 in 1998 while non-December year-end firms adopted this standard in 1999. Therefore, for December year-end firms, the pre-SFAS 131 period covers 1996 and 1997 and the post-SFAS 131 period covers 1998 and 1999. For non-December year-end firms, the pre-SFAS 131 period covers 1997 and 1998 and the post-SFAS 131 period covers 1999 and 2000.

3.2. Sample Selection

I focus on firms that provided segment information both before and after the adoption of SFAS 131 (i.e., multiple-to-multiple firms) primarily because my difference in differences analysis requires a control sample with segment information for the entire study period.[7] I begin with 33,264 firm-years and 50,389 reported business segments that appear in the segment data from Compustat for firms incorporated in the U.S. during the four-year period around the adoption of SFAS 131.[8] From these, I exclude firm-years operating in financial service industries (SIC code between 6000 and 6999) and regulated utilities industries (SIC code between 4900 and 4999), which leaves 27,851 firm-years and 40,708 firm-year-segments.[9]

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[7] It is not possible to conduct a difference in differences analysis by using single-to-multiple firms because their control group, single-to-single firms, does not provide publicly available segment information.

[8] To have only business segments in the sample, I first exclude segments whose segment type is not coded as "BUSSEG" in Compustat. In addition, I further exclude segments whose segment name starts with "elimination", "unallocated", "reconciliation", "reconciling", "intra-group", "not classified", or something like these names indicating that they are not the actual business segments but the adjustment of segment items to firm-level items.Segments with their names starting with "other", "all other", "general corporate", "corp" or "corporate" are problematic because some firms use these names to refer to the amount of adjustment of segment items to firm-level items, but other firms use these names to refer to actual business segments or the combination of minor business segments and the amount of the adjustment. In this study, I exclude the segments with these names if the segments' SIC codes are missing or any asset, sale, or capital expenditure has a negative value.

[9] The segment data from Compustat assign to each firm a SIC code, DNUM, but DNUM is constant over time because it reflects the firm's latest industry affiliation, not the history of industry affiliation. Therefore, I used a SIC code from CRSP, SICCD, to eliminate firms operating in financial services and utilities industries. However, when I examined the segments of the firms not classified as financial services or utilities firms by SICCD but classified as financial services or utilities firms by DNUM, I found that many of their segments operate in financial services or utilities industries. Therefore, I

Using the remaining firm-segment-years, I compute the number of segments for each firm-year and exclude firm-years with less than two segments, ending with 7,181 firm-years and 19,975 firm-year-segments. This is the initial sample of multiple-segment firms based on Compustat.

To identify whether a firm is a change or no-change firm, I compare a firm's segment identifiers (SIDs as reported in Compustat) in the last year before SFAS 131 was adopted (i.e., year – 1) and the firm's SIDs in the year after SFAS 131 was first applied (i.e., year + 1). For a firm to be a no-change firm, I require it to have the same number of segments in both years and have an identical SID for each segment in both years. Otherwise, it is classified as a change firm. One necessary condition for this classification is that a firm must exist as a multiple-segment firm satisfying the above sample selection criteria both in the last year before the adoption of SFAS 131 (i.e., year – 1) and in the first year after its adoption (i.e., year + 1).

The procedure described above results in 1,599 firm-years and 5,173 firm-year-segments comprising the change firm sample, and 2,057 firm-years and 5,350 firm-year-segments comprising the no-change or control firm sample (Panel A of Table 1).[10] To obtain change firms' segment data restated as required by SFAS 131, I used EDGAR, provided by the SEC (www.sec.gov), to search for the 10-Ks filed during the year they adopted SFAS 131. For firms whose 10-Ks are not available in EDGAR, I searched for their 10-Ks or annual reports through the firms' investor relations websites, where possible.[11]

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exclude firms from the sample if either DNUM or SICCD indicates they belong to financial services or utilities industries.

[10] My classification procedure is subject to several errors. First, early adopters of SFAS 131 could be wrongly classified as no-change firms. Second, firms could be wrongly classified as change firms if they acquired or divested businesses or engaged in business restructuring following the adoption of SFAS 131. However, the biases arising from such misclassifications would work against my hypotheses.

[11] While hand-collecting segment data, I found occasional discrepancies between the 10-K and Compustat data. In such instances, I adjusted the Compustat data to be consistent with the 10-K data. 11 firms originally classified as change firms based on Compustat data were reclassified as no-change firms based on the 10-K information.

Table 1. Number of Change and No-Change Firms Each Year

Panel A. Initial Multiple-Segment Firms Based on Compustat Data

	Multiple-to-Multiple Change Firms		Multiple-to-Multiple No Change Firms	
	No. of Firms	No. of Segments	No. of Firms	No. of Segments
Year -2	400	1,145	480	1,272
Year -1	432	1,244	559	1,434
Year 1	432	1,590	559	1,434
Year 2	335	1,194	459	1,210
Total	1,599	5,173	2,057	5,350

Panel B. Final Multiple-Segment Firms Based on Restated Data (Hand-Collected) and Compustat Data

	Multiple-to-Multiple Change Firms		Multiple-to-Multiple No Change Firms	
	No. of Firms	No. of Segments	No. of Firms	No. of Segments
Year -2	361	1,365	489	1,300
Year -1	398	1,499	569	1,464
Year 1	420	1,618	568	1,465
Year 2	325	1,164	463	1,222
Total	1,504	5,646	2,089	5,451

Finally, if a firm changed its fiscal year-end during the sample period, I excluded the firm-year first observed after the fiscal year-end change in order to avoid distorting the comparability of the capital allocation measure which is defined on an annual basis. Incorporating all the above adjustments, the final sample (Panel B of Table 1) consists of 1,504 firm-years and 5,646 firm-year-segments for change firms, and 2,089 firm-years and 5,451 firm-year-segments for no-change firms. Table 2 provides additional details on these firms.

4. Measure of Capital Allocation Efficiency

4.1. High *q* vs. Low *q* Segments

This study considers an internal capital market more efficient if it transfers more (less) capital to segments with high (low) growth opportunities. I use Tobin's *q* measured at the beginning of a fiscal year as a measure of growth opportunities and compute a firm's *q* as (market value of common stocks + book value of preferred stocks + book value of debt) / book value of total assets. Because a segment's *q* is not directly observed, similar to prior studies (e.g., Lang and Stulz 1994; Berger and Ofek 1995; Rajan et al. 2000, etc), I use the median *q* of single-segment firms operating in the industry in which the segment also operates as a proxy for segment's *q*.[12] The segment's industry is defined based on the narrowest SIC grouping (starting with four digits) that yields at least three single-segment firms with non-missing *q*. Following Rajan et al.'s (2000) approach, I classify a segment as a high *q* segment (a segment with high growth opportunities) if the segment's *q* is above the asset-weighted average

[12] Single-segment firms are the firms reported in Compustat during the sample period but not included in my initial sample of multiple-segment firms. Similar to sample selection criteria for multiple-segment firms, I excluded single-segment firm-years operating in financial service industries (SIC code between 6000 and 6999) and regulated utilities industries (SIC code between 4900 and 4999). Also if a firm changed its fiscal year-end during the sample period, I further excluded the first firm-year observation after the fiscal year-end change. I used SICCD from CRSP to identify single-segment firms' SIC code.

Table 2. Descriptive Statistics of Change and No-Change Firms

Panel A. Pre-SFAS 131 Period

	Change Firms		No Change Firms		Difference	t-value
	Mean	No. of Obs.	Mean	No. of Obs.		
Weighted Average Signed Transfer $_t$	-0.0001	434	0.0038	572	-0.0040	-1.17
Weighted Average Signed Subsidy $_t$	-0.0001	434	0.0117	572	-0.0118	-2.70
Concentration Ratio $_t$	0.3576	660	0.3611	972	-0.0035	-0.37
Abnormal Profit Persistence $_t$	0.7720	657	0.6530	963	0.1191	1.82
Diversity $_t$	0.2805	531	0.2992	668	-0.0188	-1.75
Market Value $_{t-1}$	$3,685,185,224	670	$1,700,378,798	859	$1,984,806,426	5.04
Institutional Ownership $_{t-1}$	0.3424	669	0.3023	856	0.0400	2.75
Number of Analysts $_{t-1}$	5.7162	673	4.1682	862	1.5480	4.11
Big Auditor $_t$	0.9340	758	0.8355	1058	0.0985	6.77
Tobin's q $_t$	1.6975	688	1.7595	898	-0.0620	-1.34
Asset $_{t-1}$	$3,463,363,239	673	$1,604,298,720	862	$1,859,064,519	5.81
Sale $_t$	$3,425,744,787	691	$1,779,857,693	903	$1,645,887,094	5.28
ROA $_t$	0.0943	673	0.0833	862	0.0110	1.67
Investment Ratio $_t$	0.0785	667	0.0826	844	-0.0041	-1.07
Diversification $_t$	0.4873	759	0.5959	1,057	-0.1086	-12.34

See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in the pre-SFAS 131 period sample.

Table 2. (Continued)

Panel B. Post-SFAS 131 Period

	Change Firms		No Change Firms		Difference	t-value
	Mean	No. of Obs.	Mean	No. of Obs.		
Weighted Average Signed Transfer $_t$	0.0048	417	-0.0032	518	0.0080	2.05
Weighted Average Signed Subsidy $_t$	0.0201	390	0.0021	459	0.0180	1.63
Concentration Ratio $_t$	0.3652	668	0.3693	912	-0.0041	-0.47
Abnormal Profit Persistence $_t$	1.0003	655	0.7346	893	0.2657	2.37
Diversity $_t$	0.3001	522	0.3206	647	-0.0205	-1.86
Market Value $_{t-1}$	$4,357,703,721	683	$2,268,756,267	852	$2,088,947,454	4.10
Institutional Ownership $_{t-1}$	0.3796	681	0.3359	857	0.0437	2.89
Number of Analysts $_{t-1}$	4.8510	745	3.3996	1031	1.4514	4.73
Big Auditor $_t$	0.9128	745	0.8070	1,031	0.1058	6.58
Tobin's q $_t$	1.6771	688	1.6762	873	0.0009	0.01
Asset $_{t-1}$	$3,491,368,739	685	$1,756,279,958	858	$1,735,088,781	5.70
Sale $_t$	$3,178,609,526	694	$1,909,741,352	883	$1,268,868,174	4.47
ROA $_t$	0.0604	685	0.0649	858	-0.0046	-0.62
Investment Ratio $_t$	0.0710	678	0.0793	840	-0.0083	-2.07
Diversification $_t$	0.4893	745	0.5971	1,031	-0.1077	-12.13

See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in the post-SFAS 131 period sample.

q of all the segments belonging to the segment's firm. Similarly, I also classify a segment as a low *q* segment (a segment with low growth opportunities) if the segment's *q* is below the asset-weighted average *q* of all the segments belonging to the segment's firm. If a firm has two segments that operate in the same industry, high *q* or low *q* segments are not defined, decreasing the size of usable sample.[13]

4.2. Measure of Cross-Segment Transfers

I use firm- and industry-adjusted investment ratio (i.e., the ratio of capital expenditure to beginning-of-period assets) developed by Rajan et al. (2000) as a measure of cross-segment transfers. This measure captures firm-adjusted differences in investment ratios between a segment of a diversified firm and its stand-alone peers operating in the same industry. The construction of this measure starts from the notion that the difference between the investment a segment made when it was a part of a diversified firm and the counterfactual investment it would have made had it been a stand-alone firm (reflected by the investment ratio adjusted by industry) would represent transfers made (if negative) or received (if positive).[14] However, if diversified firms have lower cost of borrowing and thus likely have more capital from external financing than stand-alone firms, the industry-adjusted investment ratio overestimates transfers. To correct for this, Rajan et al. (2000) further adjust each segment's industry-adjusted investment ratio by subtracting the industry-adjusted investment ratio averaged across all the segments of a firm from the segment's industry-adjusted investment ratio. Consistent with Rajan et al. (2000), I call this firm-

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[13] Using this algorithm, among 25,246 segments in the final sample, 12,655 segments (50.1%) have industry *q* based on four-digit SIC code, 5,950 (23.6%) segments have industry *q* based on three-digit SIC code, 690 segments (2.7%) have industry *q* based on two-digit SIC code, and four segments (0.0%) have industry *q* based on one-digit SIC code. The remaining 5,947 segments (23.6%) do not have industry *q* either because the segments' SIC codes are missing or because their industries do not have at least three single-segment firms with non-missing *q*.

[14] This argument is based on the assumption that all transfers made or received by a segment correspond to a decrease or increase in the segment's investment (Rajan et al. 2000).

and industry-adjusted investment ratio *Transfer* throughout this paper. Specifically, *Transfer* of segment j of firm i in year t is computed as

$$Transfer_{ijt} = \frac{CAPX_{ijt}}{BA_{ijt-1}} - \frac{CAPX^{ss}_{ijt}}{BA^{ss}_{ijt-1}} - \sum_{j=1}^{n} w_{ijt} \left(\frac{CAPX_{ijt}}{BA_{ijt-1}} - \frac{CAPX^{ss}_{ijt}}{BA^{ss}_{ijt-1}} \right),$$

where $w_{ijt} = \frac{BA_{ijt}}{\sum_{j=1}^{n} BA_{ijt}}$.

$CAPX_{ijt}$ is the capital expenditure of segment j of firm i in year t. BA_{ijt-1} is the book4 value of the assets of segment j of firm i in year t-1. [15] $CAPX_{ijt} / BA_{ijt-1}$ is the investment ratio of segment j of firm i in year t. $CAPX^{ss}_{ijt} / BA^{ss}_{ijt-1}$ is the investment ratio of a single-segment firm matched with the segment j of firm i in year t. I use the median investment ratio of single-segment firms operating in the industry in which the segment also operates as the hypothetical investment ratio the segment would have had if it had been a single-segment firm. Finally, w_{ijt} is segment j's share of total assets of firm i, and *n* is the number of segments of firm i. [16]

In addition, to estimate overall efficiency of internal capital markets, I further define *Signed Transfer* for segment j as follows:

[15] Because most firms provide restated segment information for only up to two years prior to the adoption of SFAS 131, the beginning-of-period value of segment asset is not available for the first restated year (year -2). Therefore, for the firms in this year, I compute a segment's beginning-of-period asset as end-of-period asset minus estimated net earnings of the segment. I estimate the segment's net earnings as (operating profit – imputed interest expense) * (1 – imputed tax rate) – estimated dividend paid by the segment. Imputed interest expense is computed as the product of the segment's reported sale and the median ratio of interest expense to sales of single-segment firms in the segment's industry. Imputed tax rate is computed as the median ratio of taxes paid to pretax income of single-segment firms in the segment's industry. Estimated dividend paid by the segment is computed as dividend paid by the firm multiplied by (end-of-period segment asset / sum of end-of-period segment assets of the firm).

[16] I only consider the segments whose assets and capital expenditures are not missing (so the investment ratio is computable). Instead of using firm-level assets, I use the sum of segment assets as a denominator in computing w_{ijt} to exclude the segments whose investment ratio is not computable.

Signed Transfer $_j$ = (+1) * segment j's firm- and industry-adjusted investment ratio if segment j is a high *q* segment

Signed Transfer $_j$ = (-1) * segment j's firm- and industry-adjusted investment ratio if segment j is a low *q* segment.

Signed Transfer takes a positive value if a high *q* segment receives transfers (or has a positive firm- and industry-adjusted investment ratio) or a low *q* segment makes transfers (or has a negative firm- and industry-adjusted investment ratio). In contrast, *Signed Transfer* takes a negative value if a high *q* segment makes transfers (or has a negative firm- and industry-adjusted investment ratio) or a low *q* segment receives transfers (or has a positive firm- and industry-adjusted investment ratio). Therefore, *Signed Transfer* will take a more positive value as an internal capital market allocates more capital in an efficient direction.

Finally, I compute *Weighted Average Signed Transfer* as a measure of firm-level efficiency of cross-segment transfers, using segment assets to compute weights. Specifically, W*eighted Average Signed Transfer* for firm i in year t is computed as

$$\textit{Weighted Average Signed Transfer}_{i,t} = \sum_{j=1}^{n} w_{ijt} \cdot \textit{Signed Transfer}_{ijt}$$

where $w_{ijt} = \dfrac{BA_{ijt}}{\sum_{j=1}^{n} BA_{ijt}}$.

BA_{ijt} is the book value of assets of segment j of firm i in year t w_{ijt} is segment j's share of the total assets of firm i, and n is the number of segments of firm i.[17]

[17] To compute the asset-weighted average *Signed Transfer*, I only use the segments whose *Signed Transfer* and assets are not missing. Therefore, instead of using firm-level assets, I use the sum of segment assets as a denominator in computing w_{ijt} to exclude the segments whose *Signed Transfer* or assets are missing.

5. Empirical Analyses

5.1. Segment Level Analysis

Table 3 compares capital allocation of multiple-to-multiple firms proxied for by *Transfer* between the pre- and post-SFAS 131 periods. In Panel A, when the segments of change firms are examined, the firm- and industry-adjusted investment ratio is 0.59% for low *q* segments and -0.47% for high *q* segments in the pre-SFAS 131 period. The difference between the two types of segments is 1.06% and is statistically significant, implying that more funds were transferred from high *q* segments to low *q* segments in internal capital markets in the pre-SFAS 131 period. *Signed Transfer* is -47% in the pre-SFAS 131 period, which is negative (though not statistically significant). This is consistent with the claim by prior studies that diversified firms fail to allocate capital efficiently (e.g., Berger and Ofek 1995; Scharfstein 1998; Rajan et al. 2000, etc). However, in the post-SFAS 131 period, the firm- and industry-adjusted investment ratio is -1.13% for low *q* segments and 0.66% for high *q* segments. The difference between the two types of segments is -1.79% and is statistically significant. *Signed Transfer* takes a positive value, 1.03%, and is also significant. A comparison of the pre- and post-SFAS 131 periods shows a statistically significant decrease in fund flows to low *q* segments and an increase in fund flows to high *q* segments, with *Signed Transfer* increasing by 1.50% (statistically significant). These findings suggest that internal capital markets became more efficient for diversified firms that changed their segment definitions on adopting SFAS 131.

Panel B of Table 3 examines the segments of no-change firms, my control group. In the pre-SFAS 131 period, neither the difference in the firm- and industry-adjusted investment ratio between low *q* and high *q* segments nor *Signed Transfer* is significantly different from zero. However, as a stark contrast to the change firms in Panel A, the firm- and industry-adjusted investment ratio is more positive for low *q*

Table 3. Segment-Level Analysis of *Transfer*

Panel A. Multiple-to-Multiple Change Firms

		Low *q* Segments	High *q* Segments	Low-High Difference	t-value	Signed Transfer	t-value
Pre-SFAS 131 Period	Transfer	0.0059	-0.0047	0.0106	1.82	-0.0047	-1.56
	No. Obs.	695	676			1,371	
Post-SFAS 131 Period	Transfer	-0.0113	0.0066	-0.0179	-2.35	0.0103	2.58
	No. Obs.	622	612			1,234	
	Pre-Post Diff.	0.0172	-0.0114			-0.0150	
	t-value	2.76	-1.56			-3.00	

Panel B. Multiple-to-Multiple No-Change Firms

		Low *q* Segments	High *q* Segments	Low-High Difference	t-value	Signed Transfer	t-value
Pre-SFAS 131 Period	Transfer	-0.0014	-0.0015	0.0001	0.03	0.0002	0.09
	No. Obs.	705	705			1,410	
Post-SFAS 131 Period	Transfer	0.0068	-0.0108	0.0176	2.51	-0.0081	-2.25
	No. Obs.	627	613			1,240	
	Pre-Post Diff.	-0.0082	0.0093			0.0083	
	t-value	-1.37	1.52			1.89	

Panels A and B of Table 3 compare capital allocation of multiple-to-multiple firms proxied for by *Transfer* between the pre- and post-SFAS 131 periods. A segment's *Transfer* is computed as firm- and industry-adjusted investment ratio. Investment ratio is the ratio of the segment's capital expenditure to the segment's beginning-of-period assets. Industry-adjusted investment ratio is the segment's investment ratio minus the median investment ratio of single-segment firms operating in the industry in which the segment also operates. Firm- and industry-adjusted investment ratio is the segment's industry-adjusted investment ratio minus the asset-weighted average industry-adjusted investment ratio across all segments belonging to the segment's firm. *Signed Transfer* is (+1) times *Transfer* if a segment is a high *q* segment and (-1) times *Transfer* if a segment is a low *q* segment. *Transfer* is Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample.

Table 3. (Continued)

Panel C. Difference in Differences

[1]	[2] Transfer to Low *q* Segments *Coef./t-stat*	[3] Transfer to High *q* Segments *Coef./t-stat*	[4] Signed Transfer *Coef./t-stat*
Intercept	-0.0014	-0.0015	0.0002
	-0.42	-0.43	0.09
Post 131	0.0082	-0.0093	-0.0083
	1.37	-1.52	-1.89*
Change Firm	0.0073	-0.0032	-0.0049
	1.43	-0.56	-1.26
Post 131 * Change Firm	-0.0253	0.0207	0.0233
	-2.94***	2.17**	3.50***
No. of Obs.	2,649	2,606	5,255
Adj R-Squared	0.0031	0.0015	0.0027

Panel C of Table 3 reports the results of regression analyses when *Transfer* to low *q* segments, *Transfer* to high *q* segments, and *Signed Transfer* are used as dependent variables. A segment's *Transfer* is computed as firm- and industry-adjusted investment ratio. Investment ratio is the ratio of the segment's capital expenditure to the segment's beginning-of-period assets. Industry-adjusted investment ratio is the segment's investment ratio minus the median investment ratio of single-segment firms operating in the industry in which the segment also operates. Firm- and industry-adjusted investment ratio is the segment's industry-adjusted investment ratio minus the asset-weighted average industry-adjusted investment ratio averaged across every segment belonging to the segment's firm. *Signed Transfer* is (+1) times *Transfer* if a segment is a high *q* segment and (-1) times *Transfer* if a segment is a low *q* segment. Post 131 is an indicator variable that takes a value of 1 if a segment belongs to a firm in the post-SFAS 131 period and 0 otherwise. Change Firm is an indicator variable that takes a value of 1 if a segment belongs to a change firm and 0 otherwise. Post 131 * Change Firm is a product of Post 131 and Change Firm. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

segments and more negative for high *q* segments in the post-SFAS 131 period. The difference between the two types of segments is 1.76% (statistically significant), suggesting that no-change firms transferred more funds to low *q* segments from high *q* segments. *Signed Transfer* is -0.81% (statistically significant), also suggesting that internal capital markets did not work efficiently in the post-SFAS 131 period. *Signed Transfer* decreased by 0.83% from the pre- to the post-SFAS 131 period, suggesting that no-change firms experienced a deterioration in capital allocation efficiency after the adoption of SFAS 131.[18]

Panel C of Table 3 reports the results of the difference in differences analysis, testing the hypothesis of this study. To isolate the effect of SFAS 131 from any other changes that might have occurred during the sample period, the firm- and industry-adjusted investment ratio is regressed on Post 131, Change Firm, and Post 131 * Change Firm. Post 131 is an indicator variable that takes a value of 1 if a segment belongs to a firm in the post-SFAS 131 period and 0 otherwise. Change Firm is an indicator variable that takes a value of 1 if a segment belongs to a change firm and 0

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[18] There could be two potential explanations for these findings. First, SFAS 131 requires a management approach in defining segments, but at the same time it also makes several concessions. For example, under SFAS 14, all multinational firms were required to disclose earnings by geographic areas. But under SFAS 131, firms have the option of whether or not to disclose geographic earnings if operating segments are defined on any basis other than geographic areas. This feature of SFAS 131 impaired the monitoring of managers in multinational firms (Hope and Thomas 2008). In addition, SFAS 131 "does not define segment profit or loss and does not require that whatever measure of profit or loss is reported be consistent with the attribution of assets to reportable segments. By not defining segment profit or loss, this Statement allows any measure of performance to be displayed as segment profit or loss as long as that measure is reviewed by the chief operating decision maker" (SFAS No. 131, 1997, Para. 40). To the extent that this feature of SFAS 131 harms the comparability of segment profits across firms, it may also have impaired the monitoring environment. Other criticisms against SFAS 131 include "the abandonment of the requirement that segment data conform to GAAP, the fact that internal cost allocations are subject to considerable discretion, and the concern that managers have strong incentives to manipulate internal segment information used in performance evaluation" (Berger and Hann 2003, p.165). Therefore, the net effect of SFAS 131 on monitoring could be negative if firms didn't change their segment definitions following the management approach. Second, some macroeconomic changes in the post-SFAS 131 period (e.g., the late 1990s' dot-com bubble) could have caused a firm's capital allocation to appear less efficient if the firm concealed its operations in the booming industries by segment aggregation. To the extent that no-change firms have greater propensity to hide such operations than change firms, it will create a bias in favor of my hypothesis. I conduct a battery of sensitivity tests to control for the possibility of such a bias.

otherwise. Post 131 * Change Firm, the product of Post 131 and Change Firm, is a key variable whose coefficient captures the difference in differences in capital allocation efficiency between change and no-change firms around the adoption of SFAS 131.

In column 2, when transfers to low *q* segments are examined, Post 131 * Change Firm is significantly negative, suggesting that change firms decreased transfers to low *q* segments after SFAS 131 to a greater extent than did no-change firms. In column 3, when transfers to high *q* segments are examined, Post 131 * Change Firm is significantly positive, suggesting that change firms increased transfers to high *q* segments after SFAS 131 to a greater extent than did no-change firms. Finally, in column 4, when *Signed Transfer* is examined, Post 131 * Change Firm is significantly positive, suggesting that change firms experienced greater improvement of capital allocation efficiency in the post-SFAS 131 period relative to the pre-SFAS 131 period than did no-change firms.

5.2. Endogeneity of a Firm's Reporting Choice

The above analyses assume that the adoption of SFAS 131 is an exogenous change in disclosure quality of segment information. In spite of the mandatory nature of SFAS 131, however, if managers can still exercise discretion in applying the standard, the change vs. no-change classification occurs at least partially due to strategic considerations by managers. Though discretion exercised under SFAS 131 is believed to be lower than that under SFAS 14, a selection bias could arise if a firm's reporting choice following SFAS 131 (i.e., whether or not to change its segment definitions) is correlated with firm characteristics which are also expected to influence capital allocation efficiency.

A potential candidate to be examined as an omitted variable (correlated with a firm's reporting decision) is proprietary costs. Full disclosure does not arise when a firm's disclosures provide proprietary information to competitors (e.g., Verrecchia 1983; Darrough and Stoughton 1990; Wagenhofer 1990). Prior studies identify proprietary costs as a primary cause of firms aggregating segment information (Hayes and Lundholm 1996; Nagarajan and Sridhar1996; Harris 1998; Botosan and Stanford 2005; Arya et al. 2008), which in turn may obscure efficient capital flows to the segments with the most promising opportunities. Therefore, proprietary costs may cause a bias in favor of my hypothesis if firms with high proprietary costs are more likely to aggregate their segments in a way that masks their efficient capital allocation and are also more likely to choose not to change their segment definitions on adopting SFAS 131.

Prior studies use industry concentration ratio and industry abnormal profit persistence (i.e., measures of industry competitiveness) as empirical proxies for proprietary costs. For example, Harris (1998) and Botosan and Stanford (2005) find that firms are more likely to hide their operations in industries with higher concentration ratio or higher abnormal profit persistence (i.e., less competitive industries) by aggregating segments so that they can protect abnormally high earnings trends in those industries. These studies suggest that firms tend to mask themselves to appear as if they underperform when they actually outperform their competitors. In addition, Ettredge et al. (2002) find that industry competitiveness is negatively associated with a firm's lobbying position against SFAS 131.

To examine whether no-change firms are more populated with firms that have high proprietary costs, I too focus on the two commonly used measures of industry competitiveness. A firm's concentration ratio is defined as the segment asset-weighted average Herfindahl index of industries in which the firm's segments operate. Similarly, a firm's persistence of abnormal profits is defined as the segment asset-weighted average persistence of abnormal profits of industries in which the firm's segments operate (see appendix for additional details on variable construction). Because these measures are inversely related to industry competitiveness, if a firm's reporting choice following SFAS 131 was not exogenous but strategic, the values of these two measures would be higher for no-change firms than for change firms.

However, Table 2 shows that in the pre-SFAS 131 period, the mean value of Concentration Ratio is not significantly different between change and no-change firms. Abnormal Profit Persistence is actually higher for change firms than for no-change firms, suggesting that change firms could have had a greater tendency to aggregate segments prior to SFAS 131, being forced to redefine their segments to comply with the new standard.[19]

In addition, one may argue that a firm's SFAS 131-related reporting decision is also likely to be correlated with its agency costs. If a firm with lower agency costs is more willing to become a change firm, the improved efficiency of capital allocation of change firms may be inaccurately attributed to SFAS 131. However, the results in Panel C of Table 3 do not suggest that change firms had lower agency costs prior to the adoption of SFAS 131. The negative coefficient on Change Firms in the *Signed Transfer* column suggests, instead, that change firms were characterized by greater agency costs than no-change firms.[20]

5.3. Multivariate Analyses of Capital Allocation Efficiency

As a way of addressing a potential bias arising from the endogeneity of a firm's SFAS 131 reporting choice, I include in a regression equation a wide variety of control

[19] An alternative way of measuring the competitive harm associated with SFAS 131 is to estimate cumulative market-adjusted daily returns over a three-day window around the date when the FASB first issued the Exposure Draft on SFAS 131 (Jan. 19, 1996). Firms that are more vulnerable to competitive harm caused by the management approach in segment reporting should suffer more negative returns during the three-day window around the announcement date. I do not find a significant difference in cumulative announcement returns between change and no-change firms in my sample.

[20] Firms with higher agency costs were more likely to have obscured their segment reporting until they were compelled to be more transparent.

variables believed to be correlated with both reporting choice and capital allocation efficiency. Specifically, I estimate the following regression equation.

$$\begin{aligned}
&\text{Capital Allocation Efficiency } (\textit{Weighted Average Signed Transfer})_{i,t} \\
&= \beta_0 + \beta_1 \text{ Post 131}_{t} + \beta_2 \text{ Change Firm}_{i} + \beta_3 \text{ Post 131}_{t} * \text{Change Firm}_{i} \\
&+ \beta_4 \text{ Concentration Ratio}_{i,t} + \beta_5 \text{ Abnormal Profit Persistence}_{i,t} + \beta_6 \text{ Diversity}_{i,t} \\
&+ \beta_7 \text{ Log (Market Value)}_{i,t-1} + \beta_8 \text{ Institutional Ownership}_{i,t-1} \\
&+ \beta_9 \text{ Number of Analysts}_{i,t-1} + e_{i,t}
\end{aligned}$$

Because the regression is run on a variety of firm characteristics, the dependent variable is a firm-level measure of capital allocation efficiency, *Weighted Average Signed Transfer*. Concentration Ratio and Abnormal Profit Persistence, proxies for industry competitiveness, have been found to be associated with segment aggregation (see Harris (1998) and Botosan and Stanford (2005)). Segment aggregation in turn may mask capital allocation to appear less efficient than it actually is. Diversity proxies for agency costs arising from divisional managers' power struggle. Table 2 shows a significant difference in Diversity between change and no-change firms. Rajan et al. (2000) find that as diversity in resources (proxied for by segment assets) and opportunities (proxied for by segment *q*) increases, a firm tends to allocate internal capital less efficiently. Log (Market Value) is a logged value of market equity, proxying for firm size and measured at the beginning of a fiscal period. Table 2 shows a significant difference in market value of equity between change and no-change firms. If larger firms receive more attention from the market, firm size may be correlated with monitoring and thus capital allocation efficiency. Institutional Ownership and Number of Analysts are also used as control variables because they may work as a monitoring mechanism (see Appendix C for additional details on variable construction).

Table 4 reports the results of the regression analyses. In column 2, when the baseline model is estimated without control variables, the coefficient on Post 131 * Change Firm is 0.0120 and is significant. In column 3, when the extended model is estimated with control variables, the coefficient on Post 131 * Change Firm is 0.0131 and is also significant.[21] Column 4 reports results of an industry fixed effect model estimation. If industry dummies capture industry-specific time-invariant unobservable factors correlated with a firm's reporting choice following SFAS 131, the industry fixed effect model will be useful in addressing a potential bias arising from firms' self-selection into the change or no-change group.[22] The coefficient on Post 131 * Change Firm is again positive and statistically significant. Finally, column 5 reports the results when the firm fixed effect model is estimated. In column 5, the coefficient on Post 131 * Change is also positive and statistically significant. All of these results support the hypothesis that change firms experienced greater improvement in capital allocation efficiency in the post-SFAS 131 period relative to the pre-SFAS 131 period than did no-change firms.[23]

5.4. Capital Allocation Efficiency and Firm Value

As discussed earlier, I use *Signed Transfer* as a measure of capital allocation efficiency. The assumption behind this measure is that transfers of capital from low *q* segments to high *q* segments are more value-enhancing than transfers of capital from

[21] The VIF (variance inflation factor) for each variable is between 1and 3, suggesting that multicollinearity is not a serious problem.

[22] Industry dummies are defined based on a two-digit SIC code.

[23] One may argue that the estimator that captures the difference in differences in capital allocation efficiency would be overestimated if some macroeconomic changes in the post-SFAS 131 period (e.g., the late 1990's dot-com bubble) caused no-change firms' capital allocation to appear less efficient in the post-SFAS 131 period than in the pre-SFAS 131 period if the firms concealed their operations in the booming industries by segment aggregation. To mitigate this concern, I carry out a pre-and-post analysis using a sample of change firms alone and find that change firms experienced a significant increase in capital allocation efficiency after SFAS 131.

Table 4. Regression of *Weighted Average Signed Transfer*

[1]	[2]	[3]	[4]	[5]
	Baseline Model	**Extended Model**	**Industry Fixed Effect**	**Firm Fixed Effect**
	Weighted Average Signed Transfer	Weighted Average Signed Transfer	Weighted Average Signed Transfer	Weighted Average Signed Transfer
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*	*Coef./t-stat*
Intercept	0.0038	0.0327	0.0309	0.1730
	1.71*	1.91*	1.61	1.82*
Post 131	-0.0070	-0.0074	-0.0081	-0.0088
	-2.07**	-2.00**	-2.14**	-2.15**
Change Firm	-0.0040	-0.0048	-0.0056	
	-1.17	-1.37	-1.55	
Post 131 * Change Firm	0.0120	0.0131	0.0150	0.0117
	2.31**	2.35**	2.70***	2.05**
Concentration Ratio		-0.0166	-0.0145	-0.0118
		-2.02**	-1.64	-0.98
Abnormal Profit Persistence		-0.0002	-0.0003	0.0013
		-0.32	-0.37	0.80
Diversity		-0.0206	-0.0215	-0.0336
		-2.87***	-2.96***	-1.77*
Log (Market Value)		-0.0008	-0.0007	-0.0084
		-0.95	-0.73	-1.73*
Institutional Ownership		-0.0033	-0.0035	0.0516
		-0.58	-0.56	2.63***
Number of Analysts		0.0001	0.0001	-0.0015
		0.50	0.40	-2.11**
Industry Dummies			Included	
Firm Dummies				Included
No. of Obs.	1,941	1,663	1,663	1,663
Adj R-Squared	0.0017	0.0058	0.0195	0.1812

Table 4. (Continued)

Table 4 reports the results of regression analyses when *Weighted Average Signed Transfer* is used as a dependent variable. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

high q segments to low q segments. To investigate whether *Signed Transfer* is a valid measure of capital allocation efficiency, I first examine whether W*eighted Average Signed Transfer* is a good predictor of change in firm value, proxied for by q Change, Industry-adjusted q Change, and Market- and Benchmark-adjusted Annual Returns. A firm's q Change is computed as the ratio of the firm's q measured at the end of a fiscal period to the firm's q measured at the beginning of the same period. Industry-adjusted q Change is computed as the firm's q Change minus the median q Change of single-segment firms that operate in the firm's industry. Market-adjusted Annual Return is computed by compounding the firm's monthly returns adjusted by market returns. Benchmark-adjusted Annual Return 1 is computed by compounding the firm's monthly returns adjusted by size and book-to-market. Benchmark-adjusted Annual Return 2 is computed by compounding the firm's monthly returns adjusted by size, book-to-market, and momentum (see appendix for additional details on variable construction).

Using all multiple-to-multiple firms as the sample, Table 5 shows that after controlling for earnings, change in earnings, time-invariant firm-specific characteristics, and cross-sectional common errors, W*eighted Average Signed Transfer* is significantly positive for various proxy variables representing a change in firm value. This result validates the use of *Signed Transfer* as a measure of capital allocation efficiency.

5.5. The Role of Internal Monitoring

Given that SFAS 131-type segment information was already available to managers and boards of directors before the adoption of SFAS 131, the above results would be surprising if firms have strong internal monitoring. While this study suggests that disclosure quality improves investment efficiency by strengthening external

Table 5. Value Relevance of Transfer

[1]	[2]	[3]	[4]	[5]	[6]
	q Change	Industry-adjusted *q* Change	Market-adjusted Annual Return	Benchmark-adjusted Annual Return 1	Benchmark-adjusted Annual Return 2
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*	*Coef./t-stat*	*Coef./t-stat*
Weighted Average Signed Transfer	0.7715	0.7604	0.7192	0.8511	0.8548
	4.13***	3.86***	2.25**	3.08***	3.01***
Earnings	-0.1554	-0.0708	0.6321	0.5030	0.3045
	-0.83	-0.34	1.95*	1.73*	1.04
Change in Earnings	0.2237	0.1332	0.4665	0.5341	0.5976
	1.56	0.82	2.17**	2.91***	3.13***
Firm Dummies	Included	Included	Included	Included	Included
Year Dummies	Included	Included	Included	Included	Included
No. of Obs.	1,709	1,515	1,708	1,633	1,611
Adj R-Squared	0.0556	0.0041	0.2173	0.1268	0.1073

Table 5 reports the results of regression analyses when various variables representing a change in firm value are used as dependent variables. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

monitoring, it would be also interesting to examine how the enhanced disclosure (as a mechanism to elevate external monitoring) interacts with internal monitoring to achieve higher investment efficiency. To answer this question, I conduct additional analyses by dividing the sample firms into subsamples of high vs. low internal monitoring.

More specifically, if managers under strong internal monitoring already allocated internal capital efficiently before the adoption of SFAS 131, the effect of the enhanced disclosure under SFAS 131 on capital allocation efficiency would be minimal for firms with strong corporate governance. Then the observed improvement in capital allocation efficiency after the adoption of SFAS 131 would be achieved primarily or to a greater extent by firms with weak corporate governance relative to firms with strong corporate governance. To test for the role of internal monitoring, in Panel A of Table 6, I focus specifically on the independence of boards of directors. Given that boards of directors were able to access SFAS 131-type segment information even before the adoption of SFAS 131, board independence should be the most relevant corporate governance variable that interacts with enhanced disclosures in inducing more efficient capital allocation after SFAS 131.

To examine the role of board independence, I use the data on officers and boards of directors collected from Compact Disclosure's June CD-ROMs.[24] A firm is classified as a firm with high (low) board independence if the firm belongs to the top (bottom) 40% in a distribution of board independence (i.e., the proportion of outside directors on the board who are not affiliated with the firm) measured during the four-year period before the adoption of SFAS 131. Panel A of Table 6 reports the results. In column 2, when I focus on a subsample of firms with low board independence, Post

[24] I thank Partha Sengupta for providing me with hand-collected data on officers and boards of directors from Compact Disclosure's June CD-ROMs.

Table 6. Interactive Effect of Internal Monitoring

Panel A. Board Independence

[1]	[2]	[3]	[4]
	Low Board Independence Subsample	**High Board Independence Subsample**	**Combined Subsample**
	(weak Governance)	**(Strong Governance)**	
	Weighted Average Signed Transfer	Weighted Average Signed Transfer	Weighted Average Signed Transfer
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	0.0161	-0.0215	0.0128
	0.48	-0.66	0.59
Post 131	-0.0147	-0.0013	-0.0153
	-1.62	-0.25	-1.75*
Change Firm	-0.027	-0.0025	-0.0291
	-2.78***	-0.44	-3.39***
Post 131 * Change Firm	0.0352	0.0068	0.0369
	2.46**	0.92	2.75***
Board Independence			-0.0147
			-1.83*
Post 131 * Board Independence			0.0153
			1.50
Change Firm * Board Independence			0.0289
			2.86***
Post 131 * Change Firm * Board Independence			-0.0317
			-2.07**
Concentration Ratio	-0.0051	-0.0196	-0.0118
	-0.24	-1.46	-1.00
Abnormal Profit Persistence	-0.0007	0	-0.0004
	-0.55	0.01	-0.78
Diversity	-0.0167	-0.0108	-0.0185
	-0.93	-1.03	-1.89*
Log (Market Value)	0.0000	0.0019	0.0006
	0.00	1.25	0.54
Institutional Ownership	0.0075	-0.0157	-0.0054
	0.37	-1.61	-0.59
Number of Analysts	0.0002	-0.0001	0.0001
	0.29	-0.26	0.49
Industry Dummies	Included	Included	Included
No. of Obs.	399	590	989
Adj R-Squared	-0.0071	0.0959	0.0158

Panel A of Table 6 reports the results of regression analyses when *Weighted Average Signed Transfer* is used as a dependent variable. Internal monitoring is measured by using the independence of boards of directors. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

Table 6. (Continued)

Panel B. Gompers et al.'s (2003) G-index

[1]	[2]	[3]	[4]
	Low G Subsample	**High G Subsample**	**Combined Subsample**
	(Strong Governance)	**(Weak Governance)**	
	Weighted Average Signed Transfer	Weighted Average Signed Transfer	Weighted Average Signed Transfer
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	0.0957	-0.0274	-0.0074
	1.34	-0.44	-0.2
Post 131	0.0095	-0.0018	0.0069
	1.04	-0.31	0.83
Change Firm	0.0105	-0.0015	0.0062
	0.97	-0.27	0.7
Post 131 * Change Firm	0.0052	0.0066	0.0023
	0.38	0.84	0.18
High G			0.0105
			1.4
Post 131 * High G			-0.0075
			-0.77
Change Firm * High G			-0.0068
			-0.68
Post 131 * Change Firm * High G			0.0032
			0.21
Concentration Ratio	0.0335	-0.0255	-0.0082
	1.28	-1.43	-0.58
Abnormal Profit Persistence	-0.0012	0	-0.0007
	-1.07	-0.01	-1.02
Diversity	0.0224	-0.0169	-0.0101
	0.85	-1.51	-0.95
Log (Market Value)	-0.0067	0.0016	-0.0004
	-1.90*	0.56	-0.22
Institutional Ownership	0.0083	0.0229	0.0226
	0.39	1.28	2.03**
Number of Analysts	0.0016	-0.0006	-0.0001
	1.87*	-1.43	-0.21
Industry Dummies	Included	Included	Included
No. of Obs.	173	268	441
Adj R-Squared	0.1634	0.1336	0.1195

Panel B of Table 6 reports the results of regression analyses when *Weighted Average Signed Transfer* is used as a dependent variable. Internal monitoring is measured by using Gompers et al.'s (2003) G-index. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

Table 6. (Continued)

Panel C. Bebchuk et al.'s (2009) E-index

[1]	[2] **Low E Subsample** **(Strong Governance)** Weighted Average Signed Transfer *Coef./t-stat*	[3] **High E Subsample** **(Weak Governance)** Weighted Average Signed Transfer *Coef./t-stat*	[4] **Combined Subsample** Weighted Average Signed Transfer *Coef./t-stat*
Intercept	0.0399	-0.0413	0.02
	0.60	-0.79	0.48
Post 131	0.0102	-0.0048	0.0107
	1.6	-0.88	1.65*
Change Firm	0.0073	0.0005	0.0107
	0.98	0.09	1.57
Post 131 * Change Firm	-0.0027	0.0107	-0.0049
	-0.26	1.43	-0.47
High E			0.0061
			1.07
Post 131 * High E			-0.0128
			-1.52
Change Firm * High E			-0.0072
			-0.83
Post 131 * Change Firm * High E			0.0119
			0.92
Concentration Ratio	0.0171	-0.0223	-0.0078
	0.81	-1.56	-0.64
Abnormal Profit Persistence	-0.0002	-0.0004	-0.0003
	-0.31	-0.53	-0.51
Diversity	0.0087	-0.0171	-0.0132
	0.51	-1.4	-1.36
Log (Market Value)	-0.0029	0.0023	-0.0015
	-0.97	0.93	-0.77
Institutional Ownership	0.0062	0.0117	0.015
	0.39	0.78	1.56
Number of Analysts	0.0006	-0.0005	0.0002
	0.94	-1.08	0.61
Industry Dummies	Included	Included	Included
No. of Obs.	308	281	589
Adj R-Squared	0.1038	0.1610	0.0812

Panel C of Table 6 reports the results of regression analyses when *Weighted Average Signed Transfer* is used as a dependent variable. Internal monitoring is measured by using Bebchuk et al.'s (2009) E-index. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

131 * Change Firm is significantly positive, suggesting that enhanced disclosures under SFAS 131 improved external monitoring and thereby capital allocation efficiency for firms with weak internal monitoring. In contrast, in column 3, when I focus on a subsample of firms with high board independence, Post 131 * Change Firm is not. significant, failing to provide evidence that SFAS 131 improved capital allocation efficiency for firms with strong internal monitoring. Finally, in column 4, when the two subsamples are combined, Post 131 * Change Firm is significantly positive, but the three-way interaction, Post 131 * Change Firm * Board Independence, is significantly negative, suggesting that the strength of internal monitoring moderates the effect of SFAS 131 on capital allocation efficiency. In other words, the positive effect of SFAS 131 on capital allocation efficiency was greater for firms with more severe agency problems (i.e., firms with weak internal monitoring) than for firms with less severe agency problems (i.e., firms with strong internal monitoring).[25]

Panels B and C of Table 6 report the results when Gompers et al.'s (2003) governance index (G index in Panel B) and Bebchuk et al.'s (2009) entrenchment index (E index in Panel C) are used as alternative proxies for corporate governance. These indices proxy for the level of shareholder rights as reflected in the governance provisions followed by the Investor Responsibility Research Center (i.e., the IRRC provisions). By construction, higher value of G or E index represents weaker protection of shareholder rights or greater extent of management entrenchment. Similar to board independence, a firm is classified as a firm with high (low) G or E if the firm belongs to the top (bottom) 40% in a distribution of G or E measured during

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[25] For December year-end firms, I use the average of board independence computed across 1994 to 1997. For non-December year-end firms, I use the average of board independence computed across 1995 to 1998. Because the data of boards of directors cover only a small fraction of firms in my segment database each year, merging the two data sets decreases sample size and reduces statistical power. To maximize usable observations, if a firm's board information is not available in a year, I substitute data from the closest subsequent year. Without this treatment, results are all similar except that the coefficient on Post 131 * Change Firm * Board Independence in column 4 of Table 4 falls short of conventional significance due to a lack of power.

the four-year period before the adoption of SFAS 131.[26] Using these proxies for corporate governance, however, I do not find evidence that internal monitoring significantly moderates the effect of SFAS 131 on capital allocation efficiency possibly because these proxies are not very relevant to managers' capital allocation decisions or because the regression models suffer a lack of statistical power. (Note that the magnitude and direction of the coefficients on key variables, though not statistically significant, are consistent with those in Panel A of Table 6.)

5.6. The Effect of SFAS 131 on Firm Value

So far this study has reported that 1) change firms experienced greater improvement in capital allocation efficiency than did no-change firms after SFAS 131; and 2) firm value is increasing in capital allocation efficiency. Taken together, these results suggest that change firms should experience a greater increase in firm value in the post-SFAS 131 period relative to the pre-SFAS 131 period than no-change firms. However, SFAS 131 could negatively influence firm value if more disaggregated segment disclosures cause competitive harm. Harris (1998) and Botosan and Stanford (2005) find that firms are more likely to hide their operations in less competitive industries to protect the abnormal earnings trends in those industries. Disclosures of such operations mandated under SFAS 131 could be detrimental to firm value.

To carry out a difference in differences analysis of firm value, Tobin's *q* (measured at the end of a fiscal period) is regressed on Post 131, Change Firm, and Post 131 * Change Firm, along with a variety of control variables likely to be correlated with both Tobin's *q* and the firm's SFAS 131-related reporting decision

[26] For December year-end firms, I use the average of G (or E) computed across 1994 to 1997. For non-December year-end firms, I use the average of G (or E) computed across 1995 to 1998. I use Gompers et al's (2003) G index downloaded from http://www.som.yale.edu/faculty/am859/data.html and Bebchuk et al's (2009) E index data downloaded from http://www.law.harvard.edu/faculty/bebchuk/data.shtml.

(see Appendix C for additional details on variable construction). Unlike the measure of capital allocation efficiency, Tobin's *q*, as a measure of firm value, is computed using firm-level data, not segment-level data, and thus is not subject to the potential bias arising from a differential propensity of segment aggregation between change and no-change firms.

In addition, to further examine the role of proprietary costs in moderating the effect of SFAS 131 on firm value, in Panel A of Table 7, I focus on subsamples of firms facing relatively high (low) proprietary costs (defined as firms belonging to the top (bottom) 40% of the Abnormal Profit Persistence distribution). In column 2, when the sample is limited to a subset of firms with low proprietary costs, Post 131 * Change Firm is significantly positive. In contrast, in column 3, when the sample is limited to a subset of firms with high proprietary costs, Post 131 * Change Firm is insignificant. Finally, in column 4, when the two subsamples are combined, Post 131 * Change Firm is significantly positive, but the three-way interaction Post 131 * Change Firm * Proprietary Cost is significantly negative. Of interest too is the significantly positive coefficient on Change Firms * Proprietary Costs, that captures the effectiveness of the change firms' pre-SFAS 131 segment reporting choices in protecting their competitive advantage. Consistent with earlier results, the coefficient on *Weighted Average Signed Transfer* is significantly positive. Taken together, these results suggest that SFAS 131 reduced agency costs and increased firm value, but this effect is moderated by proprietary costs.[27]

Panel B of Table 7 reports the results when I use concentration ratio as an alternative proxy for proprietary costs. If a firm operated in more concentrated (and thereby less competitive) industries prior to the adoption of SFAS 131, the firm should

[27] When I conduct a pre-and-post analysis using a sample of change firms alone, I find a significant increase in firm value after SFAS 131 for firms with low proprietary costs, but do not find a significant increase in firm value for firms with high proprietary costs.

Table 7. Regression of Firm Value

Panel A. Proprietary Cost Defined by Abnormal Profit Persistence

[1]	[2] **Low Proprietary Cost Subsample**	[3] **High Proprietary Cost Subsample**	[4] **Combined Subsample**
	q	*q*	*q*
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	1.256	0.8336	1.4474
	2.15**	1.46	3.58***
Post 131	-0.0814	0.0116	-0.0831
	-0.94	0.14	-0.96
Change Firm	-0.1857	-0.0005	-0.1509
	-2.08**	-0.01	-1.79*
Post 131 * Change Firm	0.3770	-0.0020	0.3625
	2.89***	-0.02	2.74***
Proprietary Cost			-0.0892
			-1.05
Post 131 * Proprietary Cost			0.1309
			1.09
Change Firm * Proprietary Cost			0.1881
			1.66*
Post 131 * Change Firm * Proprietary Cost			-0.3676
			-2.09**
Weighted Average Signed Transfer	1.6136	1.4242	1.2898
	1.64	1.57	1.85*
Log (Asset)	0.017	0.035	0.0073
	0.59	1.15	0.36
ROA	2.0817	2.0294	2.1322
	3.47***	3.98***	5.04***
Investment Ratio	1.8788	0.1022	0.9575
	3.34***	0.18	2.18**
Diversification	-0.0795	-0.0379	-0.0723
	-1.75*	-0.74	-2.03**
Institutional Ownership	-1.0559	-0.5535	-0.8008
	-6.97***	-3.93***	-7.22***
Number of Analysts	0.0585	0.032	0.0504
	6.97***	4.45***	8.01***
Industry Dummies	Included	Included	Included
No. of Obs.	611	620	1,231
Adj R-Squared	0.3659	0.2658	0.2843

Panel A of Table 7 reports the results of regression analyses when Tobin's *q* is used as a dependent variable. Proprietary costs are measured by using the persistence of abnormal profits of industries in which segments operate. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

Table 7. (Continued)

Panel B. Proprietary Cost Defined by Industry Concentration (using Compustat Firms)

[1]	[2]	[3]	[4]
	Low Proprietary Cost Subsample	**High Proprietary Cost Subsample**	**Combined Subsample**
	q	*q*	*q*
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	0.8296	1.6995	1.3773
	1.82*	3.19***	3.52***
Post 131	-0.0278	-0.0466	-0.0634
	-0.34	-0.53	-0.76
Change Firm	-0.1099	-0.0216	-0.049
	-1.51	-0.26	-0.68
Post 131 * Change Firm	0.2369	-0.0026	0.2653
	2.05**	-0.02	2.18**
Proprietary Cost			0.0203
			0.24
Post 131 * Proprietary Cost			0.0181
			0.15
Change Firm * Proprietary Cost			0.0018
			0.02
Post 131 * Change Firm * Proprietary Cost			-0.2397
			-1.38
Weighted Average Signed Transfer	0.6958	1.0798	1.1018
	0.99	1.10	1.76*
Log (Asset)	0.0261	-0.0166	0.0057
	1.06	-0.63	0.29
ROA	5.1683	1.2779	2.6828
	6.90***	1.83*	5.52***
Investment Ratio	0.4935	1.9672	0.9061
	0.89	2.06**	2.17**
Diversification	-0.1097	-0.0054	-0.0734
	-2.61***	-0.12	-2.13**
Institutional Ownership	-0.784	-0.4532	-0.7525
	-5.64***	-2.82***	-6.75***
Number of Analysts	0.0461	0.0468	0.0483
	6.63***	5.03***	7.86***
Industry Dummies	Included	Included	Included
No. of Obs.	667	576	1,243
Adj R-Squared	0.4688	0.3129	0.3165

Panel B of Table 7 reports the results of regression analyses when Tobin's *q* is used as a dependent variable. Proprietary costs are measured by using the Herfindahl index of industries in which segments operate based on a sample of firms in Compustat. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

Table 7. (Continued)

Panel C. Proprietary Cost Defined by Industry Concentration (from U.S. Economic Census)

[1]	[2]	[3]	[4]
	Low Proprietary Cost Subsample	**High Proprietary Cost Subsample**	**Combined Subsample**
	q	*q*	*q*
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	2.622	1.4776	1.4157
	3.65***	1.83*	2.56**
Post 131	-0.1141	0.0574	-0.0784
	-1.35	0.47	-0.85
Change Firm	-0.037	-0.0015	-0.0449
	-0.45	-0.01	-0.53
Post 131 * Change Firm	0.1106	-0.0924	0.1041
	0.99	-0.57	0.86
Proprietary Cost			0.0114
			0.11
Post 131 * Proprietary Cost			0.127
			0.84
Change Firm * Proprietary Cost			-0.0256
			-0.2
Post 131 * Change Firm * Proprietary Cost			-0.2031
			-0.99
Weighted Average Signed Transfer	2.4261	1.5181	2.1138
	1.82*	1.24	2.24**
Log (Asset)	-0.0785	0.0098	0.0015
	-2.16**	0.25	0.05
ROA	2.7282	3.138	2.5164
	4.08***	2.86***	4.16***
Investment Ratio	1.6431	0.0144	1.1419
	2.52**	0.01	1.75*
Diversification	-0.012	-0.0695	-0.0465
	-0.29	-1.19	-1.19
Institutional Ownership	-0.2291	-1.1191	-0.7245
	-1.39	-5.99***	-5.50***
Number of Analysts	0.0596	0.0586	0.0578
	4.85***	5.31***	6.78***
Industry Dummies	Included	Included	Included
No. of Obs.	489	459	948
Adj R-Squared	0.4852	0.3759	0.3445

Panel C of Table 7 reports the results of regression analyses when Tobin's *q* is used as a dependent variable. Proprietary costs are measured by using the Herfindahl index of industries in which segments operate based on the 1997 U.S. Economic Census. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

have lost greater advantage after the adoption of SFAS 131 because enhanced disclosures could cause more severe competition. To examine whether the above results hold in this alternative approach, using all Compustat firms, I compute a firm's asset-weighted average of Herfindahl index of four-digit SIC industries where the firm's segments operate in 1997 (i.e., a year in the pre-SFAS 131 period). Then I classify a firm as a firm facing high (low) proprietary costs if the firm belongs to the top (bottom) 40% in a distribution of the asset-weighted average of 1997 segment Herfindhal index. When replicating the above analyses using this alternative approach, Panel B of Table 7 shows that Post 131 * Change Firm is significantly positive in a subsample of firms with low proprietary costs but is insignificantly negative in a subsample of firms with high proprietary costs, consistent with the results in columns 2 and 3 of Panel A. However, I do not find that the coefficient on Post 131 * Change Firm in a subsample of firms with low proprietary costs is statistically significantly higher than that in a subsample of firms with high proprietary costs, possibly because of a lack of power.

Panel C of Table 7 also reports the results when I use concentration ratio as an alternative proxy for proprietary costs. But in Panel C, instead of calculating Herfindahl index by using Compustat firms, I use Herfindahl index hand-collected from the 1997 U.S. Economic Census to classify firms as ones with high vs. low proprietary costs. Ali et al. (2009) report that concentration ratio from Compustat is a poor proxy for industry competition because Compustat only covers public firms in an industry.[28] Given that private firms are not affected by SFAS 131 and thus can take advantage of the enhanced disclosures of public firms to erode their competitive advantage, the omission of private firms in measuring industry concentration (as a

[28] Ali et al. (2009) reports that the correlation between the Herfindahl index calculated by using Compustat firms and the Herfindhal index from the U.S. Economic Census is only 13%.

proxy for proprietary costs) could cause significant measurement errors. However, the weakness of this approach is that the U.S. Economic Census only provides Hefindahl indices for manufacturing industries, reducing the usable sample size and thereby the power of the test.

The 1997 U.S. Economic Census provides the value of shipments along with Hefindahl indices calculated using 50 largest firms in each six-digit North American Industry Classification System (NAICS) industries. To link this six-digit NAICS-defined Herfindahl index to my segment data with four-digit SIC industries, following the algorithm developed by Ali et al. (2009), I weight the Herfindhal index of the component six-digit NAICS industries by the square of their share of the shipments of the broader four-digit SIC industry. Then similar to above approach, I compute a firm's asset-weighted average of Herfindahl index of four-digit industries where the firm's segments operate in 1997 (i.e., a year in the pre-SFAS 131 period). Then I classify a firm as a firm facing high (low) proprietary costs if the firm belongs to the top (bottom) 40% in a distribution of the asset-weighted average of 1997 segment Herfindhal index. When replicating the above analyses using this alternative approach, Panel C of Table 7 shows that Post 131 * Change Firm is insignificantly positive in a subsample of firms with low proprietary costs, while it is insignificantly negative in a subsample of firms with high proprietary costs. The three-way interaction, Post 131 * Change Firm * and Proprietary Cost, is negative but not significant, failing to provide evidence that proprietary costs moderate the effect of SFAS 131 on firm value, possibly because of a lack of power.

6. Robustness Analyses

6.1. An Alternative Measure of Capital Allocation Efficiency

As a proxy for cross-segment transfers, the firm- and industry-adjusted investment ratio has been criticized in that it assumes that the investment opportunities facing a segment as a part of multiple-segment firms are identical to those of single-segment firms in the same industry (Maksimovi and Phillips 2002 ; Billett and Mauer 2003; Berger and Hann 2003). Billett and Mauer (2003) and Berger and Hann (2003), therefore, suggest a more direct, alternative measure of capital allocation based on the difference between a segment's capital expenditures and its cash flows (i.e., excess capital expenditures). The idea behind this measure is that a segment's excess capital expenditures represent a portion of the segment's investments subsidized by other segments or external financing.

Table 8 reports the results of regression analyses when an alternative measure of capital allocation efficiency based on excess capital expenditures, W*eighted Average Signed Subsidy*, is used as a dependent variable (see appendix for additional details on variable construction). Results are consistent with those documented earlier. In columns 2 through 5, Post 131 * Change Firm is significantly positive in every specification, again supporting the hypothesis that change firms experienced greater improvement in capital allocation efficiency in the post-SFAS 131 period relative to the pre-SFAS 131 period than did a control sample of no-change firms.

6.2. Two-Stage Analyses to Control for Self-Selection Biases

The data do not suggest that the results documented by this study are driven by self-selection biases, which could work in favor of my hypotheses if no-change firms aggregated their segments in a way that masked real capital allocation efficiency to a greater extent than did change firms. However, I conduct several sensitivity analyses to ensure that my results are robust to this possibility.

Columns 2 and 3 of Table 9 report results using the instrumental variable approach to capture change firms. In the first stage (column 2), using the sample firms

Table 8. Regression of *Weighted Average Signed Subsidy*

[1]	[2] **Baseline Model** Weighted Average Signed Subsidy *Coef./t-stat*	[3] **Extended Model** Weighted Average Signed Subsidy *Coef./t-stat*	[4] **Industry Fixed Effect** Weighted Average Signed Subsidy *Coef./t-stat*	[5] **Firm Fixed Effect** Weighted Average Signed Subsidy *Coef./t-stat*
Intercept	0.0117	0.0552	0.0525	0.0823
	3.49***	1.36	1.12	0.51
Post 131	-0.0096	-0.0052	-0.0073	-0.0085
	-1.32	-0.79	-1.08	-1.48
Change Firm	-0.0118	-0.0102	-0.0071	
	-2.70***	-2.33**	-1.39	
Post 131 * Change Firm	0.0298	0.0277	0.0305	0.0215
	2.50**	2.23**	2.43**	1.92*
Concentration Ratio		-0.0004	-0.0042	0.0074
		-0.02	-0.22	0.37
Abnormal Profit Persistence		-0.0001	-0.0004	0.0014
		-0.16	-0.49	1.36
Diversity		-0.0212	-0.0260	-0.0541
		-1.60	-1.70*	-1.67*
Log (Market Value)		-0.0017	-0.0014	-0.0037
		-0.90	-0.62	-0.45
Institutional Ownership		-0.0263	-0.0289	0.0639
		-2.44**	-2.42**	1.67*
Number of Analysts		0.0005	0.0004	-0.0025
		1.26	0.95	-1.99**
Industry Dummies			Included	
Firm Dummies				Included
No. of Obs.	1,855	1,594	1,594	1,594
Adj R-Squared	0.0025	0.0042	0.0083	0.3689

Table 8. (Continued)

Table 8 reports the results of regression analyses when *Weighted Average Signed Subsidy* is used as a dependent variable. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

Table 9. Two-Stage Analyses of *Weighted Average Signed Transfer*

[1]	[2]	[3]	[4]	[5]
	Instrumental Variable Approach		**Propensity Score Matching Approach**	
	1st Stage	2nd Stage	1st Stage	2nd Stage
	Change Firm	Weighted Average Signed Transfer	Change Firm	Weighted Average Signed Transfer
	Coef./t-stat	*Coef./z-stat*	*Coef./z-stat*	*Coef./z-stat*
Intercept	-0.6739	0.0605	-7.7032	0.0731
	-4.24***	1.73*	-17.28***	0.69
Post 131	0.0126	-0.0282		-0.0098
	0.53	-2.86***		-1.94*
Change Firm		-0.0056		-0.0104
		-0.14		-1.95*
Post 131 * Change Firm		0.0594		0.0156
		2.99***		2.09**
Concentration Ratio	0.0061	-0.0136	-0.0934	-0.0147
	0.08	-1.51	-0.50	-1.24
Abnormal Profit Persistence	0.0140	-0.0008	0.0275	0.0043
	2.14**	-0.93	1.77*	0.69
Diversity	-0.0585	-0.0213	-0.0304	-0.0298
	-0.89	-2.79***	-0.19	-2.87***
Log (Market Value)	0.0509	-0.0022	0.1551	-0.0023
	5.92***	-0.90	7.29***	-0.41
Institutional Ownership	-0.0345	-0.0041	-0.1483	-0.0085
	-0.60	-0.66	-1.07	-0.80
Number of Analysts	-0.0038	0.0003	-0.0126	0.0003
	-1.45	0.88	-2.01**	0.53
Big Auditor	0.1577		0.2466	
	3.66***		2.17**	
Industry Dummies	Included	Included	Included	Included
No. of Obs.	1,663	1,663	2,004	1,623
Adj (or Psuedo) R-Squared	0.1016	0.0194	0.0805	0.0661

Table 9. (Continued)

Table 9 reports the results of two-stage analyses when *Weighted Average Signed Transfer* is used as a dependent variable. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. In the first stage, t-statistics are estimated using heteroscedasticity-robust standard errors. In the second stage, z-statistics are estimated using bootstrap standard errors obtained by 1,000 replications. In Column 4, pseudo R^2 is reported for the probit model. In Column 5, the weighted average of adjusted R^2 in each block regression is reported for the propensity score matching approach.

whose W*eighted Average Signed Transfer* is not missing, I run a linear regression of Change Firm on every exogenous variable to be used in the second stage along with Big Auditor, a proxy for audit quality likely to influence a firm's SFAS 131-related reporting decision without being directly correlated with capital allocation. Big Auditor takes a value of 1 if Arthur Andersen, Arthur Young, Coopers & Lybrand, Ernst & Young, Deloitte & Touche, KPMG, PricewaterhouseCoopers or Touche Ross was listed by Compustat as the firm's auditor and 0 otherwise. In the second stage (column 3), I run a linear regression of W*eighted Average Signed Transfer* as before, replacing Change Firm and Post 131 * Change Firm by values obtained using the predicted value of Change Firm from the first stage. Since this procedure produces biased standard errors for coefficients, statistical significance is tested by z-value generated by bootstrap standard errors obtained by 1,000 replications. Column 3 shows that Post 131 * Change Firm is again significantly positive, consistent with earlier results.

Columns 4 and 5 report results when the propensity score matching approach is employed. In the first stage (column 4), I estimate a probit model to produce a probability that a firm chooses to be a change firm conditional on a vector of firm characteristics. This probability is the propensity score based on which change and no-change firms are to be matched. The propensity score theorem states that if the assignment to a treatment or control group is random conditional on a vector of firm characteristics, the assignment is also random conditional on the propensity score. This implies that matching of change firms with no-change firms based on comparable propensity scores would eliminate a selection bias arising from the firm characteristics (Rosenbaum and Rubin 1983). While matching can be performed in various ways, I follow Dehejia and Wahba's (1999, 2001) stratification matching method (see appendix for additional details on matching procedures). Column 5 shows matching estimators on each coefficient along with z-value generated by bootstrap standard errors obtained by 1,000 replication. Post 131 * Change Firm is again significantly positive.

Table 10 reports the results of two-stage analyses when W*eighted Average Signed Subsidy* is examined as an alternative measure of capital allocation efficiency. In columns 3 and 5, Post 131 * Change Firm is significantly positive again, supporting my hypothesis. Taken together, Tables 9 and 10 demonstrate that the results of this study are robust to a potential self-selection bias.[29]

6.3. Firm Value Analysis of Single-to-Multiple Firms

Given that Berger and Hann (2003) report a value decrease for single-to-multiple firms on adopting SFAS 131, of particular interest is whether their result can be explained by proprietary costs. To answer this question, I conduct a pre-and-post analysis of firm value for single-to-multiple firms and report the results in Table 11. Panel A shows the results when I classify a firm as a firm facing high (low) proprietary costs if the firm belongs to the top (bottom) 40% in a distribution of Abnormal Profit Persistence. In column 2, when the sample is limited to a subset of firms with low proprietary costs, Post 131 * Change Firm is not significant. In contrast, in column 3, when the sample is limited to a subset of firms with high proprietary costs, Post 131 * Change Firm is significantly negative. Finally, in column 5, when the two subsamples are combined, Post 131 * Change Firm is not significant, but Post 131 * Change Firm * Proprietary Cost is significantly negative.

Panel B shows the results when I use an alternative proxy for propriety costs,

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[29] Another way of addressing a selection bias is to use a variant of Heckman's (1979) λ as a control function. I do not report the results from this approach (although consistent with the findings described earlier) because the mandatory nature of SFAS 131 implies that firms' reporting decisions in the wake of SFAS 131 are not entirely discretionary, inconsistent with the assumption of Heckman's (1979) model.

Table 10. Two-Stage Analyses of *Weighted Average Signed Subsidy*

[1]	[2]	[3]	[4]	[5]
	Instrumental Variable Approach		**Propensity Score Matching Approach**	
	1st Stage	2nd Stage	1st Stage	2nd Stage
	Change Firm	Weighted Average Signed Subsidy	Change Firm	Weighted Average Signed Subsidy
	Coef./t-stat	*Coef./z-stat*	*Coef./z-stat*	*Coef./z-stat*
Intercept	-0.7634	0.1144	-7.7032	0.2225
	-4.68***	1.54	-17.28***	0.96
Post 131	0.0207	-0.0388		-0.0084
	0.86	-1.68*		-0.96
Change Firm		0.0151		-0.0190
		0.19		-2.16**
Post 131 * Change Firm		0.0979		0.0318
		2.22**		1.89*
Concentration Ratio	0.0021	-0.0017	-0.0934	-0.0016
	0.03	-0.09	-0.5	-0.07
Abnormal Profit Persistence	0.0137	-0.0015	0.0275	0.0096
	2.10**	-1.06	1.77*	0.86
Diversity	-0.0244	-0.0261	-0.0304	-0.0521
	-0.36	-1.64	-0.19	-2.26**
Log (Market Value)	0.0545	-0.0051	0.1551	-0.0083
	6.21***	-0.96	7.29***	-0.66
Institutional Ownership	-0.0489	-0.0292	-0.1483	-0.0478
	-0.84	-2.53**	-1.07	-2.08**
Number of Analysts	-0.0042	0.0008	-0.0126	0.0014
	-1.57	1.35	-2.01**	1.03
Big Auditor	0.1744		0.2466	
	3.98***		2.17**	
Industry Dummies	Included	Included	Included	Included
No. of Obs.	1,594	1,594	2,004	1,554
Adj R-Squared	0.1076	0.0066	0.0805	0.0358

Table 10. (Continued)

Table 10 reports the results of two-stage analyses when *Weighted Average Signed S* is used as a dependent variable. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. In the first stage, t-statistics are estimated using heteroscedasticity-robust standard errors. In the second stage, z-statistics are estimated using bootstrap standard errors obtained by 1,000 replications. In Column 4, pseudo R^2 is reported for the probit model. In Column 5, the weighted average of adjusted R^2 in each block regression is reported for the propensity score matching approach.

Table 11. Regression of Firm Value for Single-to-Multiple Firms

Panel A. Proprietary Cost Defined by Abnormal Profit Persistence

[1]	[2]	[3]	[4]
	Low Proprietary Cost Subsample	**High Proprietary Cost Subsample**	**Combined Subsample**
	q	*q*	*q*
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	3.6408	3.526	3.7931
	5.47***	4.91***	7.65***
Post 131	-0.0753	-0.1982	-0.0474
	-0.91	-2.92***	-0.59
Proprietary Cost			-0.0500
			-0.59
Post 131 * Proprietary Cost			-0.1885
			-1.84*
Log (Asset)	-0.1095	-0.1023	-0.1147
	-3.08***	-2.81***	-4.48***
ROA	0.9857	2.9881	1.6046
	1.86*	5.52***	3.99***
Investment Ratio	2.0295	0.0605	1.0147
	3.32***	0.13	2.71***
Diversification	0.0016	-0.1045	-0.032
	0.02	-2.68***	-0.75
Institutional Ownership	-0.1760	-0.5328	-0.3927
	-0.88	-3.83***	-3.28***
Number of Analysts	0.0432	0.058	0.0526
	4.60***	6.17***	7.81***
Industry Dummies	Included	Included	Included
No. of Obs.	936	987	1,923
Adj R-Squared	0.1530	0.2657	0.1807

Panel A of Table 11 reports the results of regression analyses when Tobin's *q* is used as a dependent variable in a sample of single-to-multiple firms. Proprietary costs are measured by using the persistence of abnormal profits of industries in which segments operate. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

Table 11. (Continued)

Panel B. Proprietary Cost Defined by Industry Concentration (using Compustat Firms)

[1]	[2] Low Proprietary Cost Subsample	[3] High Proprietary Cost Subsample	[4] Combined Subsample
	q	*q*	*q*
	Coef./t-stat	*Coef./t-stat*	*Coef./t-stat*
Intercept	1.6922	2.7847	2.5426
	2.15**	4.97***	5.04***
Post 131	-0.1051	-0.1081	-0.0579
	-1.26	-1.73*	-0.73
Proprietary Cost			-0.105
			-1.39
Post 131 * Proprietary Cost			-0.0887
			-0.88
Log (Asset)	-0.0026	-0.0678	-0.0485
	-0.06	-2.29**	-1.85*
ROA	1.5024	1.8402	1.8146
	2.21**	3.09***	4.13***
Investment Ratio	1.4851	3.4106	2.2422
	3.64***	3.33***	4.41***
Diversification	-0.0234	-0.1393	-0.0771
	-0.4	-2.52**	-1.94*
Institutional Ownership	-0.2978	-0.6967	-0.5502
	-1.51	-4.99***	-4.60***
Number of Analysts	0.0317	0.0775	0.0547
	3.03***	6.50***	7.01***
Industry Dummies	Included	Included	Included
No. of Obs.	986	1,003	1,989
Adj R-Squared	0.1813	0.2646	0.2131

Panel B of Table 11 reports the results of regression analyses when Tobin's *q* is used as a dependent variable in a sample of single-to-multiple firms. Proprietary costs are measured by using the Herfindahl index of industries in which segments operate based on a sample of firms in Compustat. See Appendix C for variable definitions. All computed variables are Winsorized at the first and ninety-ninth percentiles in each pre- and post-SFAS 131 sample. T-statistics are estimated using heteroscedasticity-robust standard errors.

i.e., industry concentration. More specifically, I classify a firm as a firm facing high (low) proprietary costs if the firm belongs to the top (bottom) 40% in a distribution of the asset-weighted average of 1997 segment Herfindhal index. In column 2, when the sample is limited to a subset of firms with low proprietary costs, Post 131 * Change Firm is not significant. In contrast, in column 3, when the sample is limited to a subset of firms with high proprietary costs, Post 131 * Change Firm is significantly negative. These results are consistent with those in the first two columns in Panel A. However, unlike the results in column 4 of Panel A, when the two subsamples are combined, the coefficient on the three-way interaction, Post 131 * Change Firm * Proprietary Cost, falls short of conventional significance.[30]

Overall, the results in Table 11 suggest that proprietary costs moderate the impact of SFAS 131 on firm value for single-to-multiple firms. However, I do not find a value increase for single-to-multiple firms even in a subsample of firms with low proprietary costs, suggesting that the single-to-multiple firm sample comprises a higher proportion of firms with relatively high proprietary costs (that may have caused these firms to aggregate all of their segments before SFAS 131) or that single-to-multiple firms are more penalized by the market for the newly-revealed nature of diversification than multiple-to-multiple firms.

7. Conclusion

Superseding SFAS 14, SFAS 131 requires more transparent segment disclosures and has thus improved the monitoring environment (Berger and Hann 2003). This study finds that diversified firms that changed their segment definitions on adopting

[30] I do not include *Weighted Average Signed Transfer* as an independent variable because doing so decreases usable observations by more than a half, reducing the statistical power of my test. *Weighted Average Signed Transfer* is not defined if Compustat reports the same SIC code for every segment for a firm. Single-to-multiple sample comprises many firms whose *Weighted Average Signed Transfer* is not defined for this reason.

SFAS 131 (i.e., “change firms”) experienced greater improvement in capital allocation efficiency in internal capital markets in the post-SFAS 131 period relative to the pre-SFAS 131 period than did a control sample of diversified firms that did not change their segment definitions (i.e., “no-change firms”). In addition, I find that change firms experienced a greater increase in firm value in the post-SFAS 131 period relative to the pre-SFAS 131 period than did no-change firms, except for a subsample of firms with high proprietary costs.

This study is subject to the following limitations. First, firms’ decisions to change their segment definitions on adopting SFAS 131 are at least partially endogenous and may reflect strategic choices. In particular, if no-change firms have a greater tendency to hide segments with the best opportunities, their reporting choices could create a bias in favor of my findings. The results documented in the study are robust to a battery of tests designed to address this possible bias. However, given the absence of a well-defined model to predict a firm’s reporting decision following the adoption of SFAS 131, the models used in this study could be misspecified.

Second, following Rajan et al. (2000), I measure a segment’s *q* by the median *q* of stand-alone firms in the same industry. However, because *q* is estimated using a sample of stand-alone firms, a segment’s investment, compared with the investment of stand-alone firms, is less responsive to the investment opportunities proxied for by *q*. This approach thus underestimates the efficiency of internal capital markets (Whited 2001). Despite this criticism, I follow Rajan et al.’s (2000) approach because a more direct measure of investment opportunities at segment level is not practically available. In addition, the problem pointed out by Whited (2001) is likely to be less problematic for this study because I compare investment efficiency among diversified firms, not between diversified firms and stand-alone firms.

APPENDIX A: Construction of *Subsidy*, *Signed Subsidy*, and *Weighted Average Signed Subsidy*

Billett and Mauer (2003) compute the amount of subsidy that a segment receives as max [Capital Expenditure – After-Tax Cash Flow, 0]. The segment's after-tax cash flow is computed as (Operating Profit – Imputed Interest Expense) * (1 – Imputed Tax Rate) + Depreciation. Imputed interest expense is computed as the product of the segment's reported sale and the median ratio of interest expense to sales of single-segment firms in the segment's industry. The imputed tax rate is the median ratio of taxes paid to pretax income of single-segment firms in the segment's industry.[31]

Using the amount of subsidy measured following Billett and Mauer (2003), I first compute a segment's subsidy ratio as the amount of subsidy that a segment receives divided by the segment's beginning-of-period asset. Because SFAS 131 requires firms to disclose segment information as if the information were used by internal decision-makers, firms are allowed to choose their own definitions of segment profit. Since this reduces the comparability of segment profitability across firms, I further adjust each segment's subsidy ratio by subtracting the asset-weighted average subsidy ratio of the firm to which the segment belongs from the segment's subsidy ratio. The effect of external financing is also corrected for by this firm-adjustment procedure. This study uses this firm-adjusted subsidy ratio as a proxy for the subsidy that a segment receives, and calls this proxy *Subsidy* throughout this paper. Specifically, *Subsidy* of segment j of firm i in year t is computed as

[31] Billett and Mauer (2003) note a potential measurement error that may result from the use of imputed interested expense and tax rate. Using the small size of out-of-sample segment data, they find that their imputation procedure overestimates segment after-tax cash flow and thus underestimates subsidy.

$$Subsidy_{ijt} = \frac{\max[CAPX_{ijt} - ATCF_{ijt}, 0]}{BA_{ijt-1}} - \sum_{j=1}^{n} w_{ijt} \left(\frac{\max[CAPX_{ijt} - ATCF_{ijt}, 0]}{BA_{ijt-1}} \right)$$

where $w_{ijt} = \dfrac{BA_{ijt}}{\sum_{j=1}^{n} BA_{ijt}}$

$CAPX_{ijt}$ is the capital expenditure of segment j of firm i in year t. $ATCF_{ijt}$ is after-tax cash flow of segment j of firm i in year t, estimated following Billett and Mauer's procedure (2003). BA_{ijt-1} is the book value of assets of segment j of firm i in year t-1. w_{ijt} is segment j's share of total assets of firm i, and n is the number of segments of firm i.

In addition, to estimate overall efficiency of internal capital markets, this study further defines *Signed Subsidy* for segment j as follows:

$Signed\ Subsidy_{j}$ = (+1) * segment j's firm-adjusted subsidy ratio if segment j is a high *q* segment

$Signed\ Subsidy_{j}$ = (-1) * segment j's firm- adjusted subsidy ratio if segment j is a low *q* segment.

Finally, to construct a firm-level measure of capital allocation efficiency, this study computes *Weighted Average Signed Subsidy* for firm i in year t as

$$Weighted\ Average\ Signed\ Subsidy_{i,t} = \sum_{j=1}^{n} w_{ijt} \cdot Signed\ Subsidy_{ijt}$$

where $w_{ijt} = \dfrac{BA_{ijt}}{\sum_{j=1}^{n} BA_{ijt}}$.

BA_{ijt} is the book value of assets of segment j of firm i in year t. w_{ijt} is segment j's share of total assets of firm i, and n is the number of segments of firm i.

APPENDIX B: Propensity Score Matching Procedures

If the assignment to a treatment or control group is a function of observable variables, matching methods can eliminate the bias arising from the selection on observables. Matching is relatively easy if there are only one or two variables affecting the assignment. With more than two variables, however, matching would be more difficult to implement because multiple dimensions need to be considered simultaneously. The propensity score matching method can solve this problem (i.e., the "curse of dimensionality").

Propensity score in my study is the probability that a firm chooses to be a change firm conditional on a vector of firm characteristics. The propensity score theorem states that if the assignment to a treatment or control group is random conditional on a vector of firm characteristics, the assignment is also random conditional on the propensity score. Since this theorem implies that observations with the same propensity score have the same distribution of the full vector of firm characteristics, matching of change firms with no-change firms based on comparable propensity scores can address a self-selection problem in non-experimental studies (Rosenbaum and Rubin 1983). While matching can be performed in various ways, this study follows Dehejia and Wahba's (1999, 2001) stratification matching method

More specifically, in the first stage, using every change and no-change firm in the sample, I estimate a probit model to produce a probability that a firm changes its segment definitions on adopting SFAS 131. This probability is the propensity score based on which change and no-change firms are to be matched. The probit model uses the independent variables used in the first stage of the instrumental variable approach (except for Post 131) as the predictors of a firm's decision. Then in each change and no-change sample, I sort observations from lowest to highest scores. I discard all no-change firms with an estimated propensity score lower (higher) than the minimum (maximum) of the propensity score for change firms to improve comparability between change and no-change firms.

Then I stratify all firms into blocks defined by quantiles of the propensity score distribution for change firms until every block is balanced between change and no-change firms for the propensity score. For a block to be balanced, a t-test result should indicate no significant difference in propensity scores between change and no-change firms. I begin with quintiles as a convenient starting point for the block definition, but the blocks are redefined at a later stage to be finer if all blocks are not balanced between change and no-change firms. I obtain 12 blocks satisfying this condition.

Then in each block, I run the regression of W*eighted Average Signed Transfer* (or W*eighted Average Signed Subsidy*) and compute matching estimators as the weighted average of the coefficients across the 12 block regressions. The weight is given by the number of observations used for the regressions in each block. Finally, I test the statistical significance of the coefficients by z-value generated by bootstrap standard errors obtained by 1,000 replications. Using a propensity score matching analysis, Villalonga (2004) finds that diversification does not destroy value. See Villalonga (2004) for additional details about this method.

APPENDIX C: Variable Definition

<u>Weighted Average Signed Transfer</u>: A segment's *Transfer* is computed as firm- and industry-adjusted investment ratio. Investment ratio is the ratio of the segment's capital expenditure to the segment's beginning-of-period assets. Industry-adjusted investment ratio is the segment's investment ratio minus the median investment ratio of single-segment firms operating in the industry in which the segment also operates. Firm- and industry-adjusted investment ratio is the segment's industry-adjusted investment ratio minus the asset-weighted average industry-adjusted investment ratio averaged across every segment belonging to the segment's firm. *Signed Transfer* is (+1) times *Transfer* if a segment is a high q segment and (-1) times *Transfer* if a segment is a low q segment. A firm's *Weighted Average Signed Transfer* is *Signed Transfer* averaged across segments within a firm using segment assets in computing a weight.

<u>Weighted Average Signed Subsidy</u>: A segment's *Subsidy* is computed as firm-adjusted subsidy ratio. Subsidy ratio is the ratio of the segment's subsidized amount to the segment's beginning-of-period assets. Subsidized amount is max [Capital Expenditure – After-Tax Cash Flow, 0]. After-tax cash flow is computed as (Operating Profit – Imputed Interest Expense) * (1 – Imputed Tax rate) + Depreciation. Imputed interest expense is computed as the product of the segment's reported sale and the median ratio of interest expense to sales of single-segment firms in the segment's industry. The imputed tax rate is the median ratio of taxes paid to pretax income of single-segment firms in the segment's industry. Firm-adjusted subsidy ratio is the segment's subsidy ratio minus asset-weighted average subsidy ratio averaged across every segment belonging to the segment's firm. *Signed Subsidy* is (+1) times *Subsidy* if a segment is a high q segment and (-1) times *Subsidy* if a segment is a low q segment. A firm's *Weighted Average Signed Subsidy* is *Signed Subsidy* averaged across segments within a firm using segment assets in computing a weight.

<u>Concentration Ratio</u>: A firm's Concentration Ratio is the asset-weighted average Herfindahl index of industries where the firm's segments operate, using segment

assets in computing a weight. In each industry, the Herfindahl index is computed as

Hefindahl Index = $\sum_{i=1}^{n} s_i^2 / (\sum_{i=1}^{n} s_i)^2$,

where s_i is firm i's sales and n is the number of firms in each industry.

Abnormal Profit Persistence: A firm's Abnormal Profit Persistence is the asset-weighted average persistence of abnormal profits of industries where the firm's segments operate, using segment assets in computing a weight. Following Harris (1998), the persistence of abnormal profit in each industry is estimated using the firms in Compustat between 1979 and 1998 with the following equation.

$$X_{ijt} = \beta_{0j} + \beta_{1j}(D_n X_{ijt-1}) + \beta_{2j}(D_p X_{ijt-1}) + \varepsilon_{ijt},$$

where X_{ijt} is the difference between firm i's ROA and the median ROA for its industry, j, in year t. D_n is 1 if X_{ijt-1} is not positive and 0 otherwise. D_p is 1 if X_{ijt-1} is positive and 0 otherwise. ROA is defined as the ratio of earnings before interest and taxes to beginning-of-period total assets. The slope coefficient, β_{2j}, captures the persistence of abnormal profits in each industry.

Diversity: Following Rajan et al. (2000), a firm's Diversity is computed as the standard deviation of asset-weighted *q* of its segments divided by the equally weighted average *q* of its segments. Rajan et al. (2000) measure a segment's *w* and *q* at the beginning of a fiscal period in order to be consistent with their model.

$$Diversity_{it} = \frac{\sqrt{\sum_{j=1}^{n} \frac{(w_{ijt} q_{ijt-1} - \overline{w_{ijt} q_{ijt-1}})^2}{n-1}}}{\frac{\sum_{j=1}^{n} q_{ijt-1}}{n}} \text{, where } w_{ijt} = \frac{BA_{ijt-1}}{\sum_{j=1}^{n} BA_{ijt-1}}.$$

BA_{ijt} is book value of assets of segment j of firm i in year t, w_{ijt} is segment j's share of total asset of firm i, and *n* is the number of segments of firm i.

Log (Market Value): A firm's Log (Market Value) is the natural logarithm of the market value of equity (closing price times the number of shares outstanding at the end of a fiscal year).

Institutional Ownership: A firm's Institutional Ownership is the percentage shares of the firm's equity held by institutional investors, computed as the number of shares held by 13f institutions divided by the number of shares outstanding at the end of a fiscal year. If a firm's shares are not held by 13f institutions, the firm's Institutional Ownership is set to be zero.

Number of Analysts: A firm's Number of Analysts is the number of forecast estimates used in computing a consensus forecast for a fiscal year's earnings for the last time in IBES Summary Statistics. If a firm is not covered by IBES, the firm's Number of Analysts is set to be zero.

Big Auditor: A firm's Big Auditor is a binary variable that indicates whether the firm's financial statements are audited by big auditors or not. Big Auditor takes a value of 1 if a firm's financial statements are audited by Arthur Andersen, Arthur Young, Coopers & Lybrand, Ernst & Young, Deloitte & Touche, KPMG, PricewaterhouseCoopers, and Touche Ross. Otherwise it takes a value of 0.

Tobin's *q*: A firm's Tobin's *q* is computed as (market value of common stocks + book value of preferred stocks + book value of debt) / book value of total assets.

ROA: A firm's ROA is computed as the firm's earnings before interest and taxes divided by the beginning-of-period assets.

Investment Ratio: A firm's Investment Ratio is capital expenditures divided by the beginning-of-period assets.

Diversification: A firm's Diversification is the inverse of the Herfindahl index measured using the firm's segment sales. In each firm, the Herfindahl index is computed as

Hefindahl Index = $\sum_{i=1}^{n} s_i^2 / (\sum_{i=1}^{n} s_i)^2$,

where s_i is segment i's sales and n is the number of segments in each firm.

Board Independence: Board Independence is a binary variable indicating whether a firm belongs to a subsample of firms with high or low board independence. A firm's Board Independence takes a value of 1 (0) if the firm belongs to the top (bottom) 40% in a distribution of the proportion of independent directors on the board. A firm's proportion of independent directors is computed as the number of outside directors who are not affiliated with the firm divided by the number of all directors (including officers).

High G: High G is a binary variable indicating whether a firm belongs to a subsample of firms with high or low Gompers et al's (2003) G-index. A firm's High G takes a value of 1 (0) if the firm belongs to the top (bottom) 40% in a distribution of the G-index.

High E: High E is a binary variable indicating whether a firm belongs to a subsample of firms with high or low Bebchuk et al.'s (2009) E-index. A firm's High E takes a value of 1 (0) if the firm belongs to the top (bottom) 40% in a distribution of the E-index.

Proprietary Cost: Proprietary Cost is a binary variable indicating whether a firm belongs to a subsample of high or low proprietary cost firms. A firm's Proprietary Cost takes a value of 1 (0) if the firm belongs to the top (bottom) 40% of Abnormal Profit Persistence distribution.

q Change: A firm's *q* Change is computed as the ratio of the firm's Tobin's *q* measured at the end of a fiscal period to the firm's Tobin's *q* measured at the beginning of the same period.

Industry-adjusted *q* Change: A firm's Industry-adjusted *q* Change is the firm's *q*

Change minus the median q Change of stand-alone firms that operate in the firm's industry. A firm's industry is defined based on the narrowest SIC grouping (starting with four digits) that yields at least three single-segment firms with non-missing Tobin's q.

Market-adjusted Annual Return: A firm's Market-adjusted Annual Return is computed by compounding the firm's monthly returns adjusted by market returns. To annualize monthly returns by compounding, at least six monthly returns are required.

Benchmark-adjusted Annual Return 1: A firm's Benchmark-adjusted Annual Return 1 is computed by compounding the firm's monthly returns adjusted by size and book-to-market. The size breakpoints for year t are the NYSE firms' market value of equity quintiles at the end of June of t. The market value of equity is price times shares outstanding. The book-to-market for June of year t is the book value of equity for the last fiscal year end in t-1 divided by the market value of equity for December of t-1. The book-to-market breakpoints are NYSE quintiles. The portfolios are then constructed at the end of each June. These are the intersections of five portfolios formed on size (i.e., market value of equity) and five portfolios formed on book-to-market. The benchmark portfolios include only stocks with positive book value of equity whose CRSP share codes are 10 or 11 (i.e., ordinary common stocks). This study uses breakpoints data of size and book-to-market downloaded from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Breakpoints.

Benchmark-adjusted Annual Return 2: A firm's Benchmark-adjusted Annual Return 2 is computed by compounding the firm's monthly returns adjusted by size, book-to-market, and momentum. I use market-adjusted monthly returns compounded over the preceding 12 months before portfolio formation as a proxy for momentum. Since portfolio is formed at the end of June each year, momentum in year t is measured using the market-adjusted monthly returns from July in year t-1 to June in year t.

Earnings: A firm's Earnings in year t are defined as income before extraordinary items divided by the number of shares outstanding, the whole scaled by the closing stock price at the end of year t-1.

Change in Earnings: A firm's Change in Earnings in year t is (income before extraordinary items in year t-1 minus income before extraordinary items in year t-1) divided by the number of shares outstanding, the whole scaled by the closing stock price at the end of year t-1.

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